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CANADA
DEPARTMENT OF MINES
Hon. Louis Coderre, Minister; A. P. Low, Deputy Minister.
GEOLOGICAL SURVEY
R. W. Brock, Director.

MEMOIR 41

No. 38, Geological Series

The "Fern Ledges" Carboniferous Flora of St. John, New Brunswick

By

Marie C. Stopes

OTTAWA
Government Printing Bureau
1914

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THE "FERN LEDGES" CARBONIFEROUS FLORA OF ST. JOHN, NEW BRUNSWICK.

CHAPTER I.

INTRODUCTION.

The fossil plants of the St. John "Fern Ledges" in the Little River group occupy a unique position in the annals of palaeontology owing to the extensive, and sometimes heated discussion they have aroused ever since (so long ago as 1861) Sir William Dawson began to describe them as representatives of a Devonian flora.

Sir William Dawson from time to time named and illustrated the majority of the species described from the beds (see Dawson[1] 1861, 1862, 1863, 1871, 1881, etc.). At this early date comparatively few figures of European and other American Palaeozoic fossil plants were available for his use, and so it is not surprising that Sir William made new species from most of the specimens. As a consequence, judging to-day by the list of species described from the locality, one receives the impression that the Little River flora is an isolated and a peculiar one. Whether this impression remains after an impartial examination of the facts, can better be decided at the conclusion of the present paper.

In quite recent years, Dr. Matthew—an old friend and colleague of Sir William Dawson—has been publishing revisions and additions to this interesting flora, and latterly he has

[1] The date following the author's name is a sufficient key to enable the reader to find the complete bibliographic reference in the list of papers quoted at the end of the work.

maintained that the plants are of Silurian age. Could this claim be substantiated it would make this fossil flora of unparalleled interest, for not only are Silurian plants extremely rare, but those that have come to hand have all been of a very fragmentary and unsatisfactory nature, so that palaeontologists have but little reliable information about the plants of that epoch.

It is not, however, only to palaeontologists that the question of the age of these beds is a critical one. Local stratigraphy is still undetermined, after decades of arguments and work in the field.

Nothwithstanding this double interest in the beds, there still is wanting a monograph on the plants themselves—a monograph with modern illustrations which shall disentangle the Little River plants from those of unquestioned Devonian age, and illustrate the various forms in such a manner that any palaeobotanist in whatever part of the world he lives, may be in a position to judge the facts for himself.

The feeling prevails among palaeobotanists in general that in his paper on Devonian and Upper Silurian Flora, Dawson described two quite distinct floras, though in his monograph they are inextricably mixed. This feeling is correct, and of Dawson's specimens one set represents a true Devonian flora and the other was composed of the plants from the St. John Little River group.

So long ago as 1899, Dr. Whiteaves in his address (Whiteaves, 1899, p. 216) quoted Dr. Kidston as saying in an unpublished report "a thorough revision of the work (on the St. John flora) especially in the light of subsequent collections and possible discovery of more perfectly preserved specimens, seems most desirable, and also that a better series of figures be published."

In the present paper, while I shall not omit mention of the geological bearing of the subject, from time to time, I am, as a palaeobotanist, submitting an account of the fossil *flora* of the Little River or "Fern Ledges" beds of St. John. It should be noticed further that the present work is definitely and deliberately confined to an account of the "Fern Ledges" flora, and, beyond casual mention, it will not discuss the question of the identity of these beds with others (those of Horton and Riversdale, for example), though it should here be pointed out that

it seems evident from other workers' reports that the Riversdale beds probably represent the same geological age. The St. John beds are by far the richer palaeobotanically, and from them a fine fossil flora is available for study. It need scarcely be stated now that the fossil plants from Gaspe and other places, which were described together with the St. John plants in Sir William Dawson's memoir, are not mentioned in my present report, because they are undoubtedly Devonian, and represent an entirely distinct deposit.

SHORT HISTORICAL NOTES ON PREVIOUS WORK ON THE ST. JOHN BEDS.

The controversial subject of the age of these deposits has been brought before the public on so many occasions that I shall not enter too fully into the history of the work done on them. A comparatively recent and admirable paper by White (1902) gives a very readable summary of the state of affairs up till that time. Since then Dr. Matthew has in several places urged the claims of the plants to be considered Silurian, a claim so startling to palaeontologists that the present work resulted, as a definite attempt to sift all the evidence thoroughly and impartially.

A few plants had been observed by Dr. Gesner, Dr. Robb, and others in the St. John beds, but they were not made use of and the "Fern Ledges" flora may be said to have been discovered shortly prior to 1861 by Mr. G. F. Matthew and Prof. Hartt (see Hartt's Life by Rathbun, 1878) who sent their plants to Sir William Dawson for identification and description. All the information given in Dawson's earlier work came either from Hartt, who studied the beds elaborately as can be seen from his detailed account of the section of the Fern Ledges, published in Bailey's report (see Hartt, 1865) and re-printed almost verbatim in Sir W. Dawson's Acadian Geology, 2nd Edition, or came from Dr. Matthew. In 1861, (p. 162) Dawson wrote, "of the plants described in this paper, only a few have been discovered by myself. The greater part are from the collection of Mr. G. F. Matthew of St. John, New Brunswick." Hartt planned a monograph on the flora himself (see Hartt, 1865, p. 133) for he says, "It is my intention, after having made yet more

careful examinations of the rocks of the Little River Group, to describe and figure them in a Monograph of the Flora and Fauna of the Devonian Period in the vicinity of Saint John, which paper I hope ere long to have ready for publication." This paper never appeared, but it is, probably, in manuscript, the source of several quotations from Hartt in the works of Dawson which I found it impossible to locate. At about this time Mr. (now Dr.) G. F. Matthew, who had been working for some time on the beds, published a paper on the relations of the Little River group to the rocks in the vicinity of St. John (Matthew, 1863). Thus, sent by Hartt and Matthew, the plants from the Fern Ledges went to Sir William Dawson at the time he was studying the Perry, Gaspe, and New York plants which are undoubtedly Devonian. He put all these collections together and described them as of a single period, and so his confusion was not readily detected, for, among the plants in his Devonian Flora are a number that truly are Devonian. But these were not from St. John. That at first, at any rate, he was himself a little uneasy about some of the St. John plants is clear from several remarks he makes after his identifications of species. Though by 1862 (Q.J.G.S., vol. 18, p. 303) he said "The Devonian age . . . (of the St. John beds) I regard as established by their fossils, taken in connexion with the unconformable super-position of the Lower Carboniferous conglomerate"; and though his suspicions were lulled into allowing him to say "The fossiliferous portion of the St. John series presents the richest local flora of the Devonian period ever discovered. It far excels, in number of genera and species, the Lower Carboniferous flora as it exists in British America, and is comparable with that of the Middle Coal-measures, from which, however, it differs very remarkably in the relative development of different genera, as well as in the species representing those genera;" yet a page or two on he writes "*Calamites cannaeformis* Brongniart. This species, presenting the characters which it exhibits in the coal-measures, occurs in the ledges. . . . it has not, I believe, been found previously in rocks older than the Lower Carboniferous." Again he says, "*Sphenopteris Hoeninghausi*, Brongniart. One of the ferns from the slates near St. John appears to be identical with the above species, which belongs to the Lower

Carboniferous of Europe." "*Pecopteris decurrens* sp. nov. This Fern so closely resembles *Pecopteris Serlii* and *P. lonchitica* that I should have been disposed to refer it to one or other of these species. . "; see p. 47 following, for notes about the characters on which he separates it. It is needless to multiply quotations from remarks of the kind, one more will suffice, from the 1871 monograph, page 51, where Dawson says, "In the species of *Neuropteris*, the Devonian flora approaches very nearly to that of the Carboniferous, several of the species being closely allied to common, coal formation ferns." But he does not notice that *all* the species of *Neuropteris* are from the St. John beds, and none from the Gaspe or Perry beds (which we now know to be true Devonian), a circumstance that alone would serve to put a modern palaeobotanist on his guard about the St. John flora.

As early as 1866 Geinitz pointed out that the insects described by Scudder as Devonian were on the same slab as a fragment of *Pecopteris plumosa*; he said "welches Vorkommen dafür sprechen dürfte, dass dieser Schiefer der Steinkohlenformation selbst, nicht der Devonformation, angehört." But the controversy did not take a serious aspect till thirty years later when in the Canadian Survey, Dr. R. W. Ells and Mr. H. Fletcher on the one hand, and Dr. Ami on the other, published several articles in various journals (see literature at end of this paper) and made reports in the Survey Reports for 1897, '98, '99. The subject was treated in Whiteaves' (1899) Vice-presidential address to the American Association of Science, and mention made of a report on the plants sent by Dr. Kidston to the Canadian Survey, as well as of the opinion of Mr. David White of Washington. Quoting from this report, Whiteaves (1899 p. 216) gives the following abstracts of Dr. R. Kidston's opinions —"the question of the age of the Riversdale series is inseparably connected with the question of the age of the plant beds of St. John, New Brunswick." "The species contained in the Riversdale series are also met with in the St. John plant beds, where, however, a greater number of species has been discovered." "I do not wish to express my views as to the age of the St. John plant beds too strongly, but from what I have been able to learn from a study of the literature of the subject and an examination

of specimens from these beds, it appears to me that they possess a flora of a much higher horizon than that assigned to them, and that in reality they are most probably Upper Carboniferous." "It must, however, be remembered that since Sir William Dawson wrote his work on the Pre-Carboniferous flora, very much has been done in Europe to work out the zones of the Coal Measure flo[illegible], and careful and accurate figures have been published which did not exist at the time he was carrying out his investigations."

"A thorough revision of the work, especially in the light of subsequent collections and possible discovery of more perfectly preserved specimens seems most desirable, and also that a better series of figures be published." Kidston's report is again quoted in the Summary Report of the Survey (see G. M. Dawson, 1900), and the opinion of Mr. David White is also given. "That the plant bearing beds near St. John, N.B., are not Middle Devonian as had previously been supposed, but Carboniferous, and that they are the exact equivalent of the Riversdale series of Nova Scotia." (p. 202A).

In 1899 in his account of the Coal Flora of Missouri, David White says (p. 129) "My studies, during several years, of the floras of the Devonian and Carboniferous, particularly the fossil plants of the Pottsville series, reveal so close a relationship and so great a proportion of identical species at once in the latter series and in the "[illegible]n ledges" about St. John, New Brunswick, the only locality of supposed Devonian age at which *Megalopteris* has been found, as to leave no room for doubt as to the Carboniferous age of the St. John plants. On the other hand, representatives of other characteristically Carboniferous genera so common in the beds at St. John, such as *Neuropteris*, *Alethopteris*, *Odontopteris*, and *Pecopteris*, which make the flora of that locality so unique and unparalleled among the floras of other Devonian localities, have never been discovered at any other Devonian locality." This view was further expressed in 1900, [illegible]his account of the Pottsville flora in which he finds so much [illegible]n common with the St. John "Fern Ledges" plants.

An emphatic article by Mr. Fletcher (1900, p. 235) followed this, and again p[illegible]ted the views of the stratigraphers as exemplified by hi[illegible]. and Dr. Ells. Regarding his conclusions

one should notice, as does Mr. White (1902, p. 233), that the region under discussion is highly folded, metamorphic, and extensively covered by drift and forest. Reference should be made to the paper in Science by Mr. White (1902, p. 232) where an admirable short summary of the whole controversy will be found. Dr. Ami's evidence, which strongly supported the palaeobotanist's conclusions, is quoted in another section of the present paper (see p. 126). The work of Smith and White (1905) on the Perry basin further assisted in clearing up some of the confusion in which the Devonian and supposed Devonian beds had got, but in 1906 Dr. G. F. Matthew started to revise the flora of the Fern Ledges, and took up once more the position that the flora was Devonian. A series of papers by him followed, to which reference is frequently made in the course of the present work. Then, in 1910, he published a paper on the geological age of the Little River group. In hand-writing he corrected his papers before sending them to me, changing "Devonian" to "Silurian," and in his paper in the Bulletin of the New Brunswick Natural History Society (Matthew, 1910), he lists all the Little River or Fern Ledges flora as Silurian.

In 1908 in his "Revue des Travaux de Paléontologie Végétale" M. Zeiller (1908, p. 345) reviewing Matthew's 1906 papers said, "Les autres formes.... (sont) singulièrement voisins de certains de leurs congénères houillers" (p. 346). "On ne peut que souhaiter de voir des recherches sérieuses se poursuivre tant sur la flore que sur la faune de ces couches d'âge ainsi controversé, leur attribution au Dévonien moyen cadrant mal, il faut le reconnaître, avec le faciès général de la flore."

Mr. White in a letter to Science (White, 1911) protested again against Dr. Matthew's conclusions, and reviewed the data in his paper placing the Fern Ledges flora in the Silurian.

The most recent published expression of opinion is that of Jongmans (1911) in his important revision of the Calamites, where he says in a footnote to p. 374, "Matthew rechnet diese Flora zum Devon. Sie ist jedoch rein Karbonisch....".

As I am concluding my present work, I learn by letter from Prof. Potonié of the Berg Akademie, Berlin, that he saw the McGill University collection some years ago, and that "schon

nach dem Aussehen des Gesteins offenbar unter seinen angeblichen Silurpflanzen 2 verschiedene Floren stecken, von denen die eine gewiss carbonisches Alter hat."

THE PLANT-CONTAINING BEDS—THEIR CHARACTER, DISTRIBUTION, ETC.

The classic locality for the Little River "Fern Ledges" fossil plants of St. John, is the point on the shore between high and low water at Lancaster, a mile west of the suburb of Carleton by St. John, New Brunswick. The same strata are repeated along the shore to Duck cove, where I found the most prolific beds now to lie, for the original sections at the "Fern Ledges" are both nearly worked out, and have been covered to a considerable extent by the drifting sand and gravel of the shore. The same series also outcrops to the east of St. John harbour where some plants are to be found if they are carefully sought for, but the extent of alteration in the shales is much greater here, and the fossils are seldom sufficiently well preserved to repay collection, except merely for identification in the field. Further west, the beds are reported inland, outcropping again at Musquash harbour, thence running across the peninsula to Lepreau harbour where they outcrop on the southeastern headland of the harbour. Along the shore here, fossil plants are to be found, but these specimens also have but little value beyond indicating the identity of the beds in which they occur. One may take it that practically all the plants of importance to the palaeobotanist originated from the "Fern Ledges" section of Carleton, or from one of the numerous beds a little further (1 to 1½ miles) round the coast toward, and just beyond, Duck cove.

Sir William Dawson in his 'Acadian Geology,' page 516, quotes the detailed account of the Fern Ledges section from Prof. Hartt's work (see Hartt, 1865) and quite recently Dr. Matthew has added to this some observations of his own and of Mr. W. J. Wilson, of the Geological Survey of Canada (see Matthew, 1906, p. 101 et. seq.). Dr. Matthew also, in his paper discussing the geological age of the Little River group

(Matthew, 1910C, p. 68) states that the only two basins that can without question be referred to the Little River beds, are:—"the first which has for its centre the outer harbour of St. John, the second extends from Musquash Harbour to Lepreau Harbour." The beds at Lepreau are in general appearance like those of St. John, and yield identical plants. (See Wilson, 1910, p. 276). This was confirmed also by my personal observation, so that in speaking of the whole basin I shall, for convenience sake, term them the "Fern Ledges" series.

The Fern Ledges series consists of alternations of sandstones and shales. In the compact, heavy grey sandstones, only few fossils, and these principally fragments of woody stumps, are to be found. In the numerous beds of fine grey or blackish shale, which is laminated, and in many places is considerably altered, a rich flora of debris occurs. Undue stress has been laid on the slaty aspect of this shale by the stratigraphers (see Matthew, 1910 C). The Fern Ledges flora occurs in these more or less altered shales, in various beds ranging from a couple of inches to a couple of feet in thickness. Mr. Hartt's description, when combined with Matthew's recent additions to the details of this section, gives an exhaustive record of a series of these beds, and the plants they respectively contain. I am greatly indebted to Dr. G. F. Matthew for coming with me on two excursions near St. John and pointing out the features of interest and recalling delightful reminiscences, and also for giving me local information about further excursions in the neighbourhood.

In the course of my field work, however, I found that, as a collecting ground, the original section was practically worked out. Mr. McIntosh, the curator of the Natural History Museum, St. John, very kindly showed me a bed a little further on at Duck cove which he had found rich in plant fossils. This formed the centre of my work, and extending my field of operations from it to the beds, at, and just beyond Duck cove, I spent much time collecting, and found a series of plant-containing bands far more numerous than those reported by Prof. Hartt or Dr. Matthew. The beds here dip at an angle of about 30° to 50°, and are thus convenient for working on, while they are well raised above the tide, and thus are superior to the

original Fern Ledges from the collector's point of view. There are several minor faults in these beds, which tend to repeat the series, but even allowing for this there cannot be less than 20 bands of plant-containing shales, of various thicknesses, most of them containing a great variety of plants.

At the commencement of my work, guided by the published accounts of the Fern Ledge section, I had anticipated, or, at least, hoped for, evidence that these various bands represented zones in a geological sense. It soon became evident, however, that this is not the case. It is, of course, not impossible that extensive and careful work over the whole outcrop may reveal definite assemblages in a definite sequence, but that is elaborate and time consuming work which must be left for some future enthusiast. At present, I may state that the fossils I collected at Fern Ledges itself and along the coast, were so distributed as to give no encouragement to the idea that the various bands represented true zones. Nor indeed do the details of this section given by Hartt when their contents is looked into (see p. 116-118).

The general appearance of the fine shale bands alternating with the sandstones, is that of a deltaic deposit, probably at the mouth of a great river or at its entry into a lake, or it might be, the bend of a lagoon (the remarkable lack of marine fossils in the neighbourhood renders some such view very probable). The deposit appears to have collected rapidly (geologically speaking) probably in a sheltered lagoon or wide river, and was not mixed with the coarse and current-bedded material of an exposed shore. The differences in the species of the plants brought down from time to time in the current of the river can be readily accounted for by slight changes in the course of the water, or by flood effects in different parts of its course. (See p. 118 following). We have in the Fern Ledge flora the remains of the inland flora of the period, and one which had travelled down stream as debris for some distance before being entombed. It is, therefore, natural that sometimes one, and sometimes another species should preponderate in the various beds now appearing in consecutive order; but the sequence of these plant remains depended on local, fortuitous accidents, and do not appear to be an indication of appreciable differences of geological time.

NATURE OF PRESERVATION OF SPECIMENS.

The plants in these series of beds are found in two forms:—

1. Scattered, isolated and infrequent trunks or branches, some of Calamites, but mostly of branches, of gymnospermic wood of an ancient type generally known as *Dadoxylon*. These occur principally in the sandstones alternating with the shale bands, and have been sufficiently collected and described (see Dawson's and Matthew's papers). I saw several such pieces and collected some, but they offer no new point of interest.

2. The impressions of ferns, Cordaites, Calamites, and other plants, forming the debris of a rich, mixed flora, preserved in the series of shale bands. These form the "Fern Ledges" flora proper and are the subject of the present paper.

For the palaeobotanist it is an unfortunate fact that these impressions are all very much altered. They often occur on slickensided surfaces, and locally the shales have quite a slaty cleavage. In other deposits it often happens that a so-called plant "impression" consists of the actual remains of the plant, pressed and flattened out and so far decomposed that its tissue consists of a black opaque and carbonised mass, but is still enclosed in its own cuticle so that the plant "film" can be separated from the rock enclosing it and studied. Wonderful results have been obtained with such cuticles of Carboniferous and Mesozoic age, for after suitable treatment they reveal some of their cell details under the microscope. In the present case, however, no such remains are left, for the plant impressions have been completely graphitised and most of them consist merely of a bright film or streak on the rock. This has made them difficult, not merely to study, but also to photograph, for they have no substance, and but little colour contrast with the matrix. Their bright graphitised surfaces, however, catch the light effectively when they are held at a certain angle to it, and it was in this position that all the photographs were made. I wish here particularly to emphasize the fact that the photographs reproduced in the plates are not in any way touched up or improved. The technical skill in what almost amounts to faking, has reached such a pitch in some instances that the word photograph no longer conveys any guarantee that the

object is impartially represented. I wish, therefore, to make a definite stand against the practice, and prefer to publish photographs which are entirely untouched. I may here take the opportunity of thanking Mr. Ardley of the McGill University Museum for his kindness in taking the two photos of *Alethopteris* on pl. XII and XIII, and of acknowledging the care and skill which Mr. H. G. Herring, of the British Museum, devoted to the difficult task of photographing all the other specimens illustrated.

MATERIAL USED FOR THE PRESENT WORK.

The majority of Sir William Dawson's types are now in the McGill University collection. On two occasions in Montreal, I examined the collections there, and have had the immense advantage of having nearly all the St. John specimens lent to me in London, where I could work with all the various specimens from different collections beside me together. To the Dean of the Science Faculty and the Governors of McGill University, I am greatly indebted for this inestimable assistance in my work. I am thus not only able to give photographs of most of the actual types, but it has been possible to study at length Sir William Dawson's material, and to place his specimens side by side with the European ones with which I have compared them. This was of special service in Paris—where I took over the more debatable types for consultation with M. Zeiller, the distinguished palaeobotanist of the École des Mines, to whom I am deeply indebted for help and for his remarkable kindness while I was in Paris studying the specimens in his collections.

In the St. John Natural History Museum there is also a valuable collection of St. John plants, including several of the specimens worked on by Sir William Dawson. Mr. McIntosh, the curator of the Museum of the Natural History Society, gave me every facility for seeing the specimens in his keeping while I was in St. John, and also lent me a number of the more interesting and important to bring to London for my comparative study. Several of these specimens are figured in the present paper, and for their use I am also greatly indebted.

In St. John also, Dr. Matthew kindly showed me as much of his collection as was available. He was kindness itself, and

placed all he could at my disposal, as well as going with me on two excursions in the neighbourhood. In the Geological Department of the British Museum, where I worked out the results, there are several small collections of St. John plants which had been sent by Sir William Dawson from time to time. Among these are some of his missing types, which are photographed in the present paper. There is also a larger collection of St. John plants made by Mr. Wilson. Of all these I was allowed to make full use, and I am greatly indebted to Dr. Smith Woodward, the keeper of the Geological Department, not only for this, but for permission to use the work room for the housing and study of all the borrowed collections, as well as for many personal kindnesses and help in obtaining books for the Museum Library which were wanted for my work.

While I had been in Ottawa the preceding winter, I had seen the Geological Survey collection made by M. Wilson. From this the Director kindly allowed me to have in London the specimens I required for study.

In addition to these collections now in the various museums named, I collected personally in the field in the summer of 1911, and gained a general knowledge of the distribution of the fossils in the beds, as well as a number of specimens which also came to London. Therefore, I have been privileged to have opportunities and material for comparative study of these plants which have not been available for any of the other writers on the subject, and it is owing to these exceptional facilities afforded me that I feel some confidence in the general results of the present work.

CHAPTER II.

BOTANICAL DESCRIPTION OF THE SPECIES.

In the following account many literary and nomenclatorial references are given, all indeed which it is thought could be necessary to any one working on the subject. But as so many voluminous and exhaustive monographs have been published on the Carboniferous flora from all parts of the world, I thought it needless to expand the present work by making reference to every single entry in the enormous literature on the Carboniferous relating to those species of the St. John beds which are already well known from other parts of the world. In such cases I give a reference to standard works where complete synonymies are to be found. Neither have I added the references to places where the mere names of Dawson's species have been quoted, as, for instance, frequently by Schimper in his text book, and Kidston in the British Museum Cat[illegible]e of Palaeozoic plants, where Dawson's names a[illegible]ten uncritically accepted.

My object is to shorten the present work as much as possible, without omitting anything really useful.

EQUISETALES.

Genus CALAMITES, *Suckow.*

1784. *Calamites*, Suckow, Hist. comment. Acad. elect. Theodoro-Palatinae, vol. 5, p. 355[1].

Large, tree-like forms of *Equisetum* like appearance. The casts and impressions of the stems with their alternating ribs are among the oldest recognized and best known fossils. For an account of the genus, see Jongmans, 1911, p. 42 et seq., and Kidston, 1911, p. 93, et seq.

The internal anatomy of stems, roots, leaves. and cones is now known, see Scott's "Studies" for reference to the important works on the structure of the group.

[1] This book is not in the British Museum, and so I quote from Dr. Kidston, 1911, p. 93.

CALAMITES SUCKOWI, *Brongniart.*

Plate II, figure 2.

1828. *Calamites Suckowi*, Brongniart, Hist. végét. foss., p. 124, plate XIV, fig. 6; plate XV, figs. 1–6; plate XVI.[1]
1862. *Calamites cannaeformis*, Brongniart, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 310.
1868. *Calamites cannaeformis*, Brongniart, Dawson, Acadian Geology, 2nd edition, p. 537.
1871. *Calamites cannaeformis*, Schlotheim, Dawson, Foss. Pl. Devon. Up. Silur. Canada, Geol. Surv. Rep., p. 26, plate IV, figs. 47, 48.
1906. *Calamites Suckowi*, Brongniart, Matthew, Trans. Roy. Soc. Canada, vol. 12, p. 106, plate I, fig. 4.
1906. *Calamites cannaeformis*, Schlotheim, Matthew, Trans. Roy. Soc., Canada, vol. 12, p. 105.
1910. *Calamites Suckowi* and *C. cannaeformis*, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 247.
1911. *Calamites Suckowi*, Brongniart, Jongmans, Anleit. Bestimm. Karbonpflanzen West-Europas, p. 164–178, figs. 137–144.

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[1] Brongniart's classic work, the "Histoire des Végétaux fossiles," is found in all our libraries with a single title page dated 1828, and it is widely quoted by palaeobotanists as 1828, for there is no indication in the book itself that it appeared over a number of years in separate parts. Nothing but the original paper parts can absolutely establish the contents and limits of the various sections, and these I have not been able to see, or even to hear of at our leading great libraries. But M. Zeiller (1903, p. 306) gives most detailed and careful bibliographic data about this work, to which reference should be made. From M. Zeiller I quote the pages of the separate parts of the "Histoire." Mr. C. Davies Sherborn kindly assisted me in the matter and his interpretation of the appearance of the parts in the case of the three dates about which M. Zeiller is doubtful, may be useful.

Volume I—

Part.	Pages.	Date.	
1	I–XII, 1–80	1828	
2	81–136	1828	
3	137–168	1829	
4	169–208	1829	
5	209–248	1830	
6	249–264	1831	Rec. by Geol. Soc. Lon. 16 Jan., 1832.
7	265–288	1833	Rec. by Geol. Soc. Lon. 27 Feb., 1833.
8	289–312	1833	Rec. by Geol Soc. Lon. 14 Jan., 1834.
9	313–336	1834	
10	337–368	1836	
11	369–416	1836	
12	417–488	1836	
13	Some plates, only, of vol. I, 1837.		

Volume II—

13	1–24	1837
14	25–56	838
15	–72	838

So much has been written by many authors (see Seward, 1898, p. 374 for reference to the work of Kidston, Zeiller, and others) on these difficult and poorly preserved species of *Calamites* that it will serve no useful purpose for me to elaborate the matter; more particularly as in the recent work by Dr. Jongmans (1911) we have an admirable and exhaustive treatment of the whole group of the *Calamites*. Of the species *cannaeformis* as a whole Jongmans (1911 p. 176) writes "Diese 'Art' ist....von Schlotheim sehr schlecht karakterisiert"...."es nicht zu entscheiden ist, was Schlotheim darunter verstanden hat, und dass die Exemplare, welche Brongniart dazu rechnet, fast alle schlecht erhalten sind oder zu anderen, besser definierten Formen gebracht werden können." After further illustrating the unsatisfactory nature of the species he continues—"Ich glaube, dass es deshalb am besten ist, auch *C. cannaeformis* aus der Liste der 'Arten' zu streichen oder wenigstens keine Exemplare mehr als solchen zu bestimmen."

The specimen described in 1871 by Sir William Dawson as *C. cannaeformis* is No. 3336 in the McGill University collection (see fig. 2, pl. II of the present paper). It is the best specimen of this type that I have seen in the St. John beds, and shows the characters of *C. Suckowi* (see Jongmans,1911, p. 165) well enough to make the identification reliable. Dawson recognised that this plant was the same as the Carboniferous forms, for he wrote "I have examined a number of additional specimens representing this species, from the Devonian of New Brunswick, but cannot find any characters separating it from the specimens found in the Carboniferous." Recently Dr. Matthew has gone into the subject of these specimens with great care, and he records series of detailed measurements (Matthew, 1906, pp. 106,108) and comparisons with Carboniferous forms from Joggins, Nova Scotia. He finds that in nodes of the same length the ribs in the latter are somewhat narrower, but he concludes that "the plan of structure of these stems, so widely different in age, is similar."

In some bands of shale at Duck cove, there are innumerable specimens of *Calamites* of this and other "species." They generally occur together and are less commonly mingled with the fern debris.

Calamites sp.

Plate I, figure 1; Plate III, figure 3.

1861. *Calamites transitionis*, Geoppert, Dawson, Canad. Nat., vol. 6, p. 168, fig. 5 (same cut as 1862).
1862. *Calamites transitionis*, Geoppert, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 309.
1868. *Calamites transitionis*, Geoppert, Dawson, Acadian Geol., Ed. 72, p. 536, fig. 186. (This is the same cut as in Geol. Hist. pl. fig. 27, called *C. radiatus*.)
1871. *Calamites* (*Bornia*) *transitionis*, Geopp., Dawson, Foss. Pl. Devon. Upp. Silur, Canada Geol. Surv. Rep., p. 25, pl. IV, figs. 41–46.
1888. *Calamites radiatus*, Dawson, Geol. Hist. Pl., p. 77, fig. 27 (from 1905 Ed., same cut as 1868).
1906. *Asterocalamites scrobiculoides*, Matthew, Trans. Roy. Soc., ser. 2, vol. 12, p. 112, pl. I, fig. 1.
1906. *Calamites geniculosus*, Matthew, Trans. Roy. Soc., ser. 2, vol. 12, p. 109, pl. II, fig. 5.
1910. *Asterocalamites scrobiculoides*, Matthew, Bull. Nat. Hist. Soc., New Brunswick, vol. 6, p. 247.

In plate III fig. 3 of the present paper, is illustrated a specimen similar to that figured by Dawson, 1871, pl. IV fig. 41, which is now in the McGill University collection, No. 3335. Another specimen in the same collection, No. 3339, is on a much larger scale. This is shown in fig. 1 pl. I of the present paper. It does not appear to have been illustrated before, and bears a label "Calamites radiatus, donor Sir W. Dawson." They both show clearly in some parts the way the ribs appear to run straight through the node. *C. radiatus* was evidently the name adopted by Sir W. Dawson after his chief publications on these fossil plants had appeared, and that name is applied in his "Geological History of Plants" to the same block (p. 77) as was called *C. transitionis* in "Acadian Geology," p. 537, fig. 186, and in which the ribs are shown as running straight from node to node, and not alternating as is the case in *Calamites*. Were it possible fully to establish that the ribs ran in this way in these plants, it would indicate that the plant is *Asterocalamites scrobiculatus*, Schlotheim (see Schlotheim 1820, p. 402, pl. XX fig. 4). The specimens, however, fail to show this important character conclusively, though, as figures 1 and 3 show, there is at first sight much to suggest the view that we are dealing with *A. scrobiculatus*. If the ribs be followed carefully through the nodes it will be seen that some alternate and some appear to run straight. Dr. Jongmans, who saw the specimens, was emphatic against their

inclusion in *A. scrobiculatus* and in favor of distortion and crushing as the explanation of the apparent position of the ribs; and, as he has recently completed an exhaustive comparative study of the group (See Jongmans, 1911, p. 34) his authority carries great weight. Dr. Matthew (1906, p. 112) recognises the likeness to *Asterocalamites*, but separates the St. John plants under the slightly changed name *scrobiculoides*. The evidence from the St. John specimens is still too scanty and imperfect to form the basis for a specific determination.[1]

Cones of Calamites.

Calamostachys sp.

Plate III, figure 4.

As there is a remarkable scarcity of cones in this flora, I thought it worth illustrating the small Calamite cones in the St. John Natural History Museum collections kindly lent me for the purpose. The specimen is slightly smaller than the cone of which Dr. Matthew (1906, p. 128, pl. V, fig. 4) gives an outline sketch and identifies as a new species, calling it *Palaeostachya acicularis*.

I cannot bring myself to identify specifically such incomplete fragments.

Roots of Calamites.

Pinnularia dispalans, *Dawson*.

1862. *Pinnularia dispalans*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 312, pl. XIII, fig. 22.
1868. *Pinnularia dispalans*, Dawson, Acadian Geol., ed. 2, p. 541, fig. 194L.
1871. *Pinnularia dispalans*, Dawson, Foss. Pl., Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 33, pl. VII, figs. 74–76.
1888. *Pinnularia dispalans*, Dawson, Geol. Hist. Pl., p. 82, fig. 31L (from 1905 edition).
1910. *Pinnularia dispalans*, Dawson, Matthew, Bull. Nat. Hist. Soc., New Brunswick, vol. 6, p. 247.

Pinnularia elongata, *Dawson*.

1871. *Pinnularia elongata*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 33, pl. VII, fig. 77.
1910. *Pinnularia elongata*, Dawson, Matthew, Bull. Nat. Hist. Soc., New Brunswick, vol. 6, p. 247.

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[1] While this was in the hands of the printer I received a letter from M. Renier in which he states that he thinks *C. ramosus* and *C. undulatus* occur in these deposits.

These branching rootlets are sufficiently described and illustrated by Dawson. They occur as flattened impressions, and do not penetrate the rocks in such a way as to indicate that the plants grew *in situ*.

Genus ASTEROPHYLLITES, *Brongniart.*

1822. *Asterophyllites*—Brongniart, Classif. végét. foss., p. 210 (pars).

Calamitean foliage. Generally showing whorls of branches, each with whorls of leaves. The leaves lineal and single nerved. The leaves in one whorl uniform in length, but the whorls vary according to their position on the plant. See Jongmans, 1911, p. 202 et seq. for a recent account of the genus.

ASTEROPHYLLITES ACICULARIS, *Dawson.*

(Pars = *A. equisetiformis*, Schl.)

Plate IV, figure 6.

1868. *Asterophyllites acicularis*, Dawson, Acadian Geol., ed. 2, p. 537, fig. 194, H. & H2.
1862. *Asterophyllites acicularis*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 310, pl. XIII, fig. 16.
1871. *Asterophyllites acicularis*, Dawson, Foss. Pl. Devon. Upp. Silur., Canada, Geol. Surv. Rep., p. 28, pl. V, figs. 54–57.
1888. *Asterophyllites acicularis*, Dawson, Geol. Hist. Pl., p. 82, fig. 31 H (in 1905 Ed.)
1900. *Asterophyllites acicularis*, Dawson, Kidston in Ami. Ottawa Nat., vol. 14, p. 100 (=*Calamocladus equisetiformis*, Schlotheim sp.).
1906. *Annularia acicularis*, (Dawson) Matthew, Trans. Roy. Soc. Canada, ser. 2, vol. 12, p. 127, pl. V, figs. 1, 2, 3.
1910. *Annularia acicularis*, (Dawson) Matthew, Trans. Roy. Soc. Canada, ser. 3, vol. 3, p. 94.
1910. *Annularia acicularis*, (Dawson) Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 247.
Cf. 1911. *Asterophyllites equisetiformis*. Schl. Jongmans Anleit. Bestimm. Karbon. West Europas, pp. 204–208.

All the specimens which I have seen are exceedingly fragmentary and really indeterminable. Some of those figured earlier (e.g. Dawson 1862, pl. XIII, fig. 16) might very well be a delicate form of *A. radiata*. In figure 6, pl. IV of the present paper, is shown the original of Dawson's fig. 54, pl. V, in his 1871 monograph, which is now in the McGill University collections, No. 3333. It can hardly be doubted that this specimen corresponds with *A. equisetiformis* so far as it goes.

Mr. David White (1900, p. 898) records this species from the Pottsville of the United States, but does not illustrate his

specimens. He mentions, however, that it is closely related to *A radiata*, so that his specimens are probably like those of the species figured by Dawson, 1862. It is evident that Dawson's "species" contains at least two types of foliage, so that, were the specimens better preserved it would be necessary to revise his terminology, but from such material as is available it is impossible to make conclusive determinations.

Asterophyllites parvulus, *Dawson.*

(=*A. grandis* Sternb. sp?)

1861. *Asterophyllites parvula*, Dawson, Canad. Nat., vol. 6, p. 168, fig. 6.
1862. *Asterophyllites parvula*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 311.
1868. *Asterophyllites parvula*, Dawson, Acadian Geol., p. 539, fig. 188A.
1871. *Asterophyllites parvula*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep. p. 27.
1900. *Asterophyllites parvulus*, Dawson, David White, Pottsville Formn., p. 897.
1906. *Asterophyllites parvulus*, Dawson, Matthew, Trans. Roy. Soc. Canada, vol. 12, p. 122, pl. VI, figs. 1, 2, and *var*, p. 123, pl. vi, fig. 3.
1910. *Asterophyllites parvulus*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 247.

The specimens appear very small and unsatisfactory, and it is doubtful whether the name should be retained. The fig. 3 of Matthew's pl. vi bears considerable resemblance to *A. grandis* (see Jongmans, 1911, p. 224) with which M. Zeiller considers it should be included. I have not seen any specimens, and, therefore, retain the name temporarily, but without the intention further to establish it. Mr. David White (1900, p. 897), identifies some very small specimens of *Asterophyllites* from Pottsville with Dawson's St. John species, and notes the likeness to *A. grandis*.

Asterophyllites sp.

[=*Annularia radiata*?]

Plate IV, figure 5.

1868. *Asterophyllites laxa* (?), Dawson, Acadian Geol., p. 539.
1871. *Asterophyllites lenta*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada Geol. Surv. Rep., p. 29, pl. V, fig. 60.
1906. *Asterophyllites lentus*, Dawson, Matthew, Trans. Roy. Soc. Canada, vol. 12, p. 122, pl. V, figs. 5, 6, 7.
1910. *Asterophyllites lentus*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 247.

The only specimens which I have seen are very considerably altered, and poorly preserved, and it appears to me that it is the slight distortion of the specimens which make them appear "quite distinct in form and habit."

The specimen figured in pl. IV, fig. 5 of the present paper is the type of the 'species' *lentus* and is the original of Dawson's fig. 60. pl. V in his 1871 monograph. It is now No. 3340 in the McGill University collection, and illustrates the doubtful nature of the species. It appears possible that the specimens belong to *A. radiata* and reference should be made to Jongmans (1911, p. 252) for the synonymy and description of that species.

Genus ANNULARIA, *Sternberg.*

1821. *Annularia*, Sternberg. Versuch. Fl. Vorwelt., fasc. 2, p. 32.

This genus of Calamitean foliage was defined in 1828 by Brongniart (Prodrome p. 155) as follows:—"Tige grêle, articulée, à rameaux opposés naissant au-dessus des feuilles. Feuilles verticillées planes, le plus souvent obtuses, traversées par une seule nervure, soudées entre elles à leur base, de longeur inégale."

For a recent account of the genus see Jongmans, 1911, p. 235 et seq.

ANNULARIA SPHENOPHYLLOIDES, *Zenker* sp.

Plate V, figure 7.

1833. *Galium sphenophylloides*, Zenker, Neues Jahrb. Stuggart, p. 398, pl. V, figs. 6–9.
1837. *Annularia sphenophylloides*, Zenker, Gutbier, Isis, 1837, p. 436.
1911. *Annularia sphenophylloides*, Zenker, Jongmans Anleit. Beschreib. Karbon-pflans. West Europas, pp. 260–263, figs. 211, 212 (for complete synonymy).

The specimen illustrated by fig. 7, pl. V of the present paper is in the British Museum Geological Department, V. 4174, and was obtained in Mr. Wilson's collection in 1900. The specimen was too dull to photograph as it was, so that I had slightly to varnish it before the photograph was taken. The species has not been described from the St. John beds previously, and in general appearance it closely resembles the European form. It also coincides with it in the size of the leaflets (5-8 mm. in length and 2 in width), in the number of free leaflets in a whorl (about a

dozen), and in the whorl of leaves from which the branches spring. The Canadian specimen is not sufficiently well preserved to show clearly the simple median nerve which is characteristic of the species, but it is suggested in one or two of the leaflets. The matrix is not like the fine black slaty shales which provide most of the plants, but is more sandy, approaching the sandstones between the shale beds. There is with the specimen no record stating in which bed of the "Fern Ledges" it was found. Dawson records the species from the Carboniferous of Nova Scotia, and Mr. David White (1899 and 1900) lists it both from the Missouri Coal Measures, and from the Pottsville of the States.

Annularia stellata (*Schlotheim*) *Wood.*

1820. *Casuarinites stellatus*, Schlotheim, Petrefactenkunde, p. 397.
1860. *Annularia stellata*, Wood, Proc. Acad. Nat. Sci. Philadelphia, p. 236.
1906. *Annularia longifolia*, Brongn. mut. *Leavitti* Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 5, p. 396, pl. IX.
1906. *Annularia longifolia*, Brongn. mut. *Leavitti* Matthew, Trans. Roy. Soc. Canada, vol. 12, p. 124, pl. VII, fig. 1.
1911. *Annularia stellata*, Schlotheim, Jongmans, Anleit. Bestimm. Karbonpflanzen West-Europas, pp. 238–250, figs. 193–203 (for complete synonymy).

The plant has been described recently, and well figured by Dr. Matthew under the name *A. longifolia* Brongniart, and to his descriptions I have only to add that the greater size of his leaves than those of the specimens commonly figured of this species, is probably merely dependent on the age and condition of the plant. His plant *may* be a local variety, but the use of the word "mutation" in such a connexion cannot be supported on any grounds.

Jongmans (1911, p. 238) places Brongniart's species, *Annularia longifolia* (including Lesquereux's American representatives of the form) as described also by Schimper, Geinitz, Renault, Zittel and many other writers, in *Annularia stellata* Schlotheim. Reference should also be made to the extensive synonymy, and description by Mr. David White (1899, p. 159) of the species from the Coal Measures of Missouri where it is abundant.

Annularia latifolia (*Dawson*) *Kidston*.

[= *A. stellata*?]

Plate VI, figures 10, 11, 12; Plate VII, 13.

1862. *Asterophyllites latifolia*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 311, pl. XIII., fig. 17.
1868. *Asterophyllites latifolia*, Dawson, Acadian Geol. Ed. 2, p. 538, fig. 187, A.B.D.
1871. *Asterophyllites latifolia*, Dawson, Foss. Pl. Devon Upp. Silur. Canada, Geol. Surv. Rep., p. 28, pl. V, figs. 50-53.
1886. *Annularia latifolia* (Dawson), Kidston, Cat. Palaeos. Pl. p. 236.
1888. *Asterophyllites latifolia*, Dawson, Geol. Hist. Pl., p. 78, fig. 28A, B. & D. (From 1905 edition).
1900. *Annularia latifolia* (Dawson), David White, Pottsville Form. p. 898.
1906. *Annularia latifolia* var. *minor*, Matthew, Trans. Roy. Soc. Canada, vol. 12, p. 126, pl. VII, figs. 4, 5.
1906. *Annularia latifolia* (Dawson), Matthew, Trans. Roy. Soc. Canada, vol. 12, p. 125, pl. VII, figs. 2 and 3.
1910. *Annularia latifolia-minor*, Matthew, Trans. Roy. Soc. Canada, vol. 3, ser. 3, p. 94.
1910. *Annularia latifolia* and *A. latifolia* mut. *minor* (Dawson), Matthew, Bull. Nat. Hist. Soc. N. Brunswick, vol. 6, p. 247.
(cf. 1911 *Annularia stellata*, Schlotheim, Jongmans Anleit., p. 238, etc.)

The names of the various species of foliage belonging to *Annularia* are still in considerable confusion, and it is difficult to make determinations of exact species. Consequently, I keep Dawson's name for the small, compact species of *Annularia* which is common in the St. John deposits. The characteristic appearance of this is illustrated in pl. VI, figures 10-12, pl. VII, fig. 13, in the present paper. Figure 10, pl. VI, is the original of fig. 51 in Dawson's (1871) pl. V, and is now No. 3347 in the McGill University collection. Another, in the same collection (No. 3348) is much like that illustrated in 1862, and in the cut on p. 538 in "Acadian Geology," but it is not certain that it is the original of these illustrations (Cf. pl. VI, fig. 11 in the present paper). Another specimen, No. 3332, is illustrated in fig. 12, pl. VI, and this also shows a portion of a cone which may be compared with Dawson's pl. V, fig. 53.

A further example of the foliage whorls is seen in fig. 13, pl. VI, in the present paper, from No. V 4148 in the British Museum.

In this Canadian form, particularly noticeable in the specimen illustrated in pl. VI, fig. 11, the width of the leaves is slightly greater than is quite typical of *A. stellata* but this is a very

trifling differenc[illegible] ongmans who saw the specimens all together in the Br[illegible]sh Museum, when he visited me while I was concluding my work, expressed himself as confident that the plant should be included in *A. stellata*. The slightly greater width of the leaves, and the fact that the Canadian specimens are not well enough preserved or complete enough to make their identity *absolutely* certain, induces me to enter them still under Dawson's name.

SPHENOPHYLLALES

Genus SPHENOPHYLLUM, *Brongniart*

1828. *Sphenophyllum* Brongniart, Prodrome, p. 68.

Founded for delicate stems bearing whorls of wedge-shaped leaves, the genus is now best known from its internal anatomy. Reference should be made to Scott's studies for the structure of these plants, and for the impressions to Jongmans, 1911, p. 367 et seq.

SPHENOPHYLLUM ANTIQUUM, *Dawson*

1861. *Sphenophyllum antiquum*, Dawson, Canad. Nat., vol. 6, p. 170, fig. 7.
1862. *Sphenophyllum antiquum*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 312.
1868. *Sphenophyllum antiquum*, Dawson, Acadian Geol., Ed. 2, p. 540, Fig. 188 B.
1871. *Sphenophyllum antiquum*, Dawson, Foss Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 32, pl. V, figs. 61, 62.
1888. *Sphenophyllum antiquum*, Dawson, Geol. Hist. Pl., p. 365 (from 1905 edition).
1906. *Sphenophyllum antiquum*, Dawson, Matthew, Trans. Roy. Soc. Canada, vol. 12, p. 129, pl. III, fig. 3.
1910. *Sphenophyllum antiquum*, Dawson, Matthew, Bull. Nat. Hist. Soc., New Brunswick, vol. 6, p. 247.

As Dawson (1871 p. 32) said, "This sole Devonian representative of its genus appears to have been very rare." Dr. Matthew (1906 p. 129) also remarks on the rarity of the plant, and states that he has no specimens which are better than Sir William Dawson's. Consequently, we are still in possession of very imperfect knowledge of the species, for, as Schimper pointed out in his text book (vol. 1), the diagnosis of the Canadian plant is incomplete. The fig. 61 pl. V in Dawson's paper (1871) shows three whorls of leaves of spheno-

phyllum-like general appearance, but without detail. Their salient character appears to be the small size of the leaves which are "less than one-fourth of an inch long," and only measure 3mm in the illustration. Dawson's enlargement of a part of one leaf showing the veins, is reproduced by Matthew. I have not seen this original, nor found any other specimen which I could recognize as *Sphenophyllum*.

Potonié (1899 p. 185) remarks that *S. antiquum* of *Dawson* is very like *S. cuneifolium*, but is much smaller leaved.

SPHENOPHYLLUM (?) CUNEIFOLIUM (*Sternberg*) *Zeiller.*

1823. *Rotularia cuneifolia*, Sternberg Versuch, Fasc. 2, p. 33, pl. XXVI, figs. 4a, 4b.
1880. *Spenophyllum cuneifolium*, Zeiller, Végét. foss. terr. houill. France, p. 30, pl. CLXI, figs. 1, 2.
1910. *Sphenophyllum gemma*, Matthew, Trans. Roy. Soc. Canada., ser 3, vol. 3, p. 96, pl. VI, fig. 7.
1910. *Sphenophyllum latum* and *S. latum var. minus*, Matthew, Trans. Roy. Soc. Canada, ser. 3, vol. 3, p. 95, pl. VI, figs. 5, 6.
1911. *Sphenophyllum cuneifolium*, Sternb. Jongmans, Anleit, Karbonpfl. West Europas, p. 377.

Jongmans (1911, p. 374) considers that it is probable that "*S. gemma*" of Matthew is *S. cuneifolium* v. *saxifragaefolium* Sternberg. With *S. Schlotheimii*, with which Matthew compares it, he thinks it has nothing to do. Of *S. latum* and *S. latum var. minus*, Matthew, Jongmans says they "gehören wahrscheinlich zu *S. cuneifolium* Sternberg," but they are really too fragmentary to make it worth while to enter into detailed identifications, though they are interesting, because any specimens of Sphenophyllum are so very rare in these deposits.

LYCOPODIALES.

LEPIDODENDRON sp. foliage twigs.

[=*Lycopodites Matthewi* Dawson].

1861. *Lycopodites Matthewi*, Dawson, Canad. Nat., vol. 6, p. 171, fig. 8.
1862. *Lycopodites Matthewi*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 314.
1868. *Lycopodites Matthewi*, Dawson, Acadian Geol., Ed. 2, p. 542, fig. 188c.
1871. *Lycopodites Matthewi*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 35, pl. VIII, figs. 85-87.
1910. *Lycopodites Matthewi*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p 248.

The specimens on which this species was founded were exceedingly minute scraps, and in 1871 (p. 35) Dawson himself says "Additional specimens show this to have been a more woody plant than I had at first supposed, and possibly branchlets of some slender Lepidodendron of the type of *L. acuminata* of Goeppert." These fragments are of greater interest from the St. John beds than they would be from a deposit in which *Lepidodendron* is abundant, because there are so very few specimens of any kind of the Lycopodiales. They are quite indeterminable specifically, but they afford evidence of the existence of Lepidodendrons in the deposit (see p. 122).

Lycopod foliage

Leaves of Sigillaria or Lepidodendron.

1871. *Cyperites* sp. (leaves of Sigillaria), Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 24, pl. III, figs. 36-37.

Although Dawson described these specimens as the leaves of *Sigillaria*, he used the old name *Cyperites*, which must, of course, be abandoned now. In his monograph, in 1871, he recorded specimens both from St. John, and from Perry. The latter (fig. 38 pl. III) are put by Smith and White (1905 p. 70) in the species *Leptophloeum rhombicum* Dn., of which they give the complete synonymy. The fragments from St. John are merely portions of uncharacterised leaves which cannot be associated with any definite form of stem. It is unlikely that they belong to the same species as the Perry leaves.

In the collections of the St. John Natural History Museum, a specimen shows two nicely ribbed leaves like that in fig. 36 pl. III. of Dawson's monograph. It is impossible to determine whether they are the leaves of *Lepidodendron* or *Sigillaria*.

Lepidodendron sp. in "Bergeria" condition.

[*Lepidodendron Gaspianum* Dawson (from St. John, *not* from Perry)]

1859. *Lepidodendron Gaspianum*, Dawson, Quart. Journ. Geol. Soc., vol. 15, p. 483, figs. 3, 3*a-d*.

1862. *Lepidodendron Gaspianum*. Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 312, pl. XIV, figs. 26, 27, 28, and pl. XVII, fig. 58.

1868. *Lepidodendron Gaspianum*, Dawson, Acadian Geol. ed. 2, p. 541, (fig. 189 A).
1871. *Lepidodendron Gaspianum*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 33 (pl. VIII, figs. 82-84).
1888. *Lepidodendron Gaspianum*, Dawson, Geol. Hist. Pl. p. 66 (fig. 21) (from 1905 edition).
1905. "*Bergeria*" (*Lepidodendron* = Erhaltungszustand), Fischer in Potonié, Abbild. Beschreib, Lief. 3, No. 42.

In so far as *L. Gaspianum* is a true species at all (which point I leave to those who are working on the Devonian to determine) it belongs to the Devonian deposits (see Crépin, 1875, p. 218. pls. I-V.) as it was originally described from Gaspe, and then from the Perry beds. Dawson (1862 p. 313) speaks of numerous and beautiful specimens from New York State, but Smith and White (1905 p. 79) mention that they did not see recognisable specimens of the species from the Perry beds. Fischer in Potonié (1905, Lief. 3. No. 42) includes *L. Gaspianum* in the "Bergeria" condition of *Lepidodendron*.

In 1871 (p. 33) Dawson gives further figures and again mentions the species as occurring in the St. John beds, but does not specify any determinable specimen as coming from that locality. The specimen now in McGill University collection, No. 3286, given by Sir W. Dawson from St. John, is a small fragment of a very incomplete cast of a *Lepidodendron*, 5cm long and about 1·5 cm broad, but with no true limit of width as it is entirely fr[illegible]tary. It is recognisable merely as evidence of the exi[illegible] a specimen of *Lepidodendron*, and is not determinable [illegible].

SIGILLARIA sp. (indeterminable.)

Plate V, Figure 8

[= *Sigillaria palpebra* Dawson.]

1862. *Sigillaria palpebra*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 307, pl. XIII, fig. 12.
1868. *Sigillaria palpebra*, Dawson, Acadian Geol. Ed. 2, p. 536.
1871. *Sigillaria palpebra*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 2
1910. *Sigillaria palpebra*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.

The type, and I believe the only specimen of this species is in the McGill University collection, No. 3346. This is shown in fig. 8 pl. V of the present paper, reference to which will

demonstrate how impossible it is to diagnose a true species from it. All that Dawson says of it is "Ribs narrow, about a quarter of an inch in width. Leaf scars transversely acuminate, small. My only specimen is a small fragment, showing three or four ribs, and with only a few of the scars preserved. The most perfect leaf-scars are shaped much like a half-closed eye; but the specimen is only a cast, and very imperfect." (Dawson, 1862, p. 307).

The actual specimen is just sufficiently preserved to show that it really was a *Sigillaria*, but is specifically indeterminable. It is, however, of some interest and importance because it is the only representative of this group of plants which are so common in many deposits containing a similar flora in other parts of the world.

STIGMARIA FICOIDES *Brongniart*

1820. *Variolaria ficoides*, Sternberg, Versuch, Fasc. 1, p. 22 and pl. XII, figs. 1-3.
1822. *Stigmaria ficoides*, Brongniart, Mém. Mus. d'Hist. Nat., vol. 8, Paris, p. 228, pl. 1 (XII.), fig. 7.
1862. *Stigmaria ficoides* (variety), Brongniart, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 309.
1868. *Stigmaria ficoides* (variety), Brongniart, Dawson, Acadian Geol. Ed. 2, pl. 536.
1871. *Stigmaria perlata*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. [illegible] pl. III., fig. 32.
1910. *Stigmaria perlata*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.
1910. *Stigmaria ficoides*, Brongniart, Seward Fossil Plants, vol. 2, p. 231.
1911. *Stigmaria ficoides*, Brongniart, Kidston, Végét. houill. Hainaut Belge. p. 212 (for complete synonymy).

"Large roots of *Stigmaria*, in some instances with rootlets attached, occur, though rarely, in the sandstones or arenaceous shale near St. John—only two or three specimens having been found. They are not distinguishable from some varieties of the *Stigmaria ficoides* of the Coal-measures" (Dawson p. 309, 1862). I did not observe any further examples of plants *in situ* in these deposits, so have to depend entirely on Dawson's descriptions.

In 1871 Dawson (p. 22) names the plants which he recorded in 1862, but does not add any further data. He gives, without comment, the following diagnosis:—"Areoles large, distinct, surrounded by a circular rim or margin; bark irregularly rugose." The plate illustrates a small piece of *Stigmaria* which has no

characters distinctive enough to separate it from *Stigmaria ficoides* which is an aggregate "species" founded simply to accommodate temporarily the roots of Lepidodendrons and Sigillarias.

LYCOPODIALES. (?)

Genus PSILOPHYTON, *Dawson*.

1859. *Psilophyton*, Dawson, Quart. Journ. Geol. Soc., vol. 15, p. 478.

The genus was founded by Dawson for Devonian plants from Gaspe with a delicate, slender, and branching habit. Their nature has been much discussed, and though they have been recognised widely in various fossil floras, Nathorst (1894 p. 12) agrees with Schenk, Solms Laubach and other palaeobotanists that the value of this "genus" is "beinache gleich null" and considers that of the so-called species, only *Psilophyton princeps* shows anything like distinctive characters. It is most probable that very many of the fragments called "Psilophyton" are maccrated rachises of ferns or of Lycopods.

Weiss in 1889 maintained that the "genus" *Psilophyton* of Dawson was already covered by Goeppert's *Drepanophycus* in 1852. But owing to the non-algal nature of the plants composing it, he suggested *Drepanophytum* to include *Psilophyton princeps* and other forms. To Weiss' position Dawson (1889) took objection, pointing out that the priority of *Psilophyton* stood, as "*Drepanophycus*" was an entirely unsuitable generic name for the Canadian plants, and that if it was to be altered to *Drepanophytum* this latter genus would then date only from 1889, while *Psilophyton* itself had stood from 1859.

Smith and White (1905) and Seward (1910) both give critical accounts of the genus to which reference should be made. It appears evident that the only plants in the genus which have any claim to be considered as independent organisms, are of Devonian age. The St. John specimens can lay little claim to a permanent identity. Nevertheless, though the "genus" is so doubtful, it is perhaps convenient to retain it to designate some of the fragments that have been so much discussed in palaeobotanical literature.

PSILOPHYTON ELEGANS *Dawson*.

Plate V, figure 9.

1862. *Psilophyton elegans*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 315, pl. XIV, figs. 29, 30; and pl. XV, fig. 42.
1868. *Psilophyton elegans*, Dawson, Acadian Geol., ed. 2, p. 543, fig. 189 B.C.
1871. *Psilophyton elegans*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 40. pl. X, figs. 122, 123.
1888. *Psilophyton elegans*, Dawson, Geol. Hist. Pl., p. 66, fig. 21 (from 1905 edition).
1908 (?). *Psilophyton elegans*, Dawson, Matthew, Trans. Roy. Soc. Canada, ser. 3, vol. 1, p. 190.
1910. *Psilophyton elegans*, Dawson, Matthew, Trans. Roy. Soc. Canada, ser. 3, vol. 3, p. 91, pl. V, figs. 1–5.
1910. *Psilophyton elegans*, Dawson, Matthew, Oldest Silur. Fl., Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.
1911. *Psilophyton elegans*, Dawson, Matthew, Review Fl. Little R. Group, Trans. Roy. Soc. Canada, ser. 3, vol. 4, p. 10.

It is difficult, if not impossible, to say anything of ultimate valu e about the diverse fragments of impressions which have been described as a species of *Psilophyton* under the specific name *elegans*. The obscurity of the impressions and the consequent lack of botanical determination make their description purely nominal. Dawson's original figures (1862, pl. XIV. figs. 29, 30) of the type of this plant are well known, for they have been repeated in his "Acadian Geology," "Geological History of Plants," and recently by Couffon (1909) and others. The slender, tufted and curving segments (whether stems or leaves is uncertain) form the principal feature of the plant because the fructifications assigned to it are extremely doubtful. Sir William Dawson in 1871 (p. 41) wrote "My recent discoveries as to the fructification of *Psilophyton* render it probable that the little clusters of leaf-like bodies from St. John which I referred to the species *Annularia acuminata* are really the spore-cases of this species." A conclusion in which he is tacitly followed by Couffon (1909, p.94). No evidence in support of this view is available, and it should be noted that Matthew (1910 A, p. 83) has allocated these fruits to the plant called *Alethopteris discrepans* by Dawson. (ref. p. 48 and p. 73 present work). On the other hand, the fruit that Matthew allies with *Psilophyton elegans* appears no better accredited. In his plate V fig. 2 he illustrates a slab

bearing some curved branches of *Psilophyton* and a fruit stalk bifurcating to bear two capsule or seed-like bodies. (*C*). There is no evidence beyond association that these fragments belong to each other, and when Dr. Matthew kindly showed me his originals it became evident that he had drawn his figures in the way they are from considerations of space, because the fructification and the vegetative parts are on different slabs of matrix. Furthermore, I think it very likely that his fructification *C* fig. 2, and fig. 5 pl. V. are fragments of the fertile branch I illustrate (pl. XIII, fig. 45), and which presumably belongs to a pteridosperm (see p. 74).

The bifurcations of several of the less tufted specimens of this "species" suggest that it belonged to one of the Lycopodineae, and it is not unlikely that some at any rate of the fragments were pieces of ultimate twigs and branchlets of a small-leaved *Lepidodendron*, that was partly macerated. It is also more than likely that other and different macerated scraps have been included in the "species." From a specimen kindly lent me by the St. John Natural History Society, I am able to illustrate the appearance of a small characteristic fragment (see pl. V, fig. 9).

FILICALES AND PTERIDOSPERMALES.

Genus SPHENOPTERIS, *Brongniart.*

1822. *Filicites*, section, *Sphenopteris*, Brongniart, Class. végét. foss., p. 233.
1828. *Sphenopteris*, Brongniart, Prodrome, p. 50.

The genus does not approximate to a true one in a modern sense and it includes a number of forms which are certainly not ferns at all, but Pteridosperms. It is made to include the impressions of vegetative fronds of fern-like appearance of which the rachis may dichotomise or branch pinnately, and the pinnules are small, the laminae generally lobed, and the veins dictomise, running from a midrib at an angle. The forms included in the genus vary with each author, and many other genera, such as *Diplothmema*, *Hymenophyllites*, *Oligocarpia*, etc., have been separated from types sometimes included in *Sphenopteris*.

Sphenopteris marginata, *Dawson.*

[= *Sphenopteris rotundifolia*, Andrä.]

Plate VIII, figures 18, 19, 20 and text fig. 1.

1862. *Sphenopteris marginata*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 231, pl. XV, fig. 38B.
1868. *Sphenopteris marginata*, Dawson, Acadian Geol., p. 551, fig. 192D.
1869. *Sphenopteris rotundifolia*, Andrä, Vorwelt. Pflanz-Rheinl., p. 37, pl. XII.
1871. *Sphenopteris marginata*, Dawson, Foss. Pl. Devon. Upp. Sil., p. 52, pl. XVI, fig. 184.
1888. *Sphenopteris marginata*, Dawson, Geol. Hist. Pl., p. 73, fig. 23D (from the 1905 edition).
1900. *Sphenopteris marginata*, Dawson, Kidston in Ami, Ottawa Naturalist, vol. 14, p. 100.
1900. *Sphenopteris marginata*, Dawson, Kidston in Ami, Trans. Nova Scotia Inst. Sci., vol. 10, pp. 168 and 169.
1910. *Sphenopteris marginata*, Dawson, Matthew, Oldest Silur. Fl., Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.

I have retained Dawson's name for this species, but recognise that it may have to yield to Andrä's because the figures published by Dawson in 1862 were of very small fragments and they do not sufficiently characterise the species. But, on the other hand, there is no doubt about the type. In Dawson's later description he gives a larger figure (1871, pl. XVI. fig. 184) of a specimen which is now in the McGill University collection, No. 3317, labelled in Dawson's writing as the type. A photograph of this is given in fig. 18, pl. VIII of the present paper. A second specimen of Dawson's shows the form of the pinnules rather more clearly (see fig. 19, pl. VIII). These photographs should be compared with Andrä's (1869 plate XII) when the great l' eness between them will be at once apparent. Unfortunately, owing to the graphitization and slight alteration of the Canadian specimens, the finer branches of the veins are destroyed, but in those pinnules in which any of the veining is preserved, it agrees entirely (so far as it goes) with that shown in fig. 2a in Andrä's plate XII. The plant appears to be fairly common in the St. John beds, and there are specimens in the collection of the Natural History Society of St. John, and also in the British Museum. One of these (v. 4087 of the British Museum Geological Department) is shown in pl. VIII, fig. 20, of

the present paper, and illustrates a larger portion of the leaf than those in Dawson's collection, showing the pinnae attached to a rachis.

Dawson's description was very short (p. 52):—"This resembles the last species (*S. Hoeninghausi*) in general form, but is larger, with the pinnules round or round-ovate, divided into three or five rounded lobes, and united by a broad base to the broadly winged petiole." The "broadly winged petiole" is not shown in the drawing (fig. 184 pl. XVI, Dawson, 1871) nor, as far as I can see, is it present in either the type specimen or any other I have examined. In the final tips of some of the pinnae, the small pinnules are slightly confluent at the base, to which Dawson's remark may possibly refer.

An enlargment of some of the pinnules and their venation, so far as it is preserved, indicates the character of the leaflets, and shows their simple rounded form, which is their salient feature.

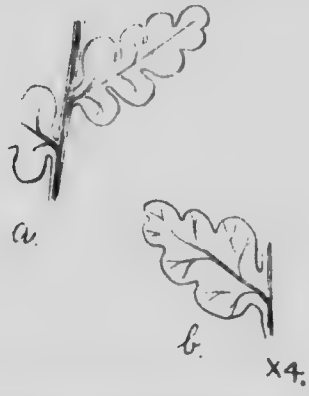

Fig. 1. Sphenopteris marginata, Dawson. Enlargement of pinnules. *a*, typical pinnule; *b*, the most completely preserved venation of a pinnule.

Though it is not possible to affirm positively that this plant is identical with the European *S. rotundifolia* because of the loss of the finer veins in the Canadian specimens, yet there seems little doubt that they are the same, and M. Zeiller expressed himself as finding the greatest likeness between them.

Sphenopteris valida, *Dawson*, sp.

[=*Sphenopteris artemisiaefolioides*, Crépin].

Plate IX, figure 21. Plate X, figures 22, 23 and text fig. 2.

1848. *Sphenopteris artemisiaefolia*, Sauveur (non Sternberg), Vég. foss. terr. houill. Belg., pl. XX, figs. 1, 2 (*not* 3).
1862. *Cyclopteris valida*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 319, pl. XVII, fig. 52.
1868. *Cyclopteris valida*, Dawson, Acadian Geol., ed. 2, p. 547, fig. 192B.
1871. *Cyclopteris* (*Aneimites*) *valida*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 46, pl. XVI, fig. 190.
1876. *Eremopteris artemisiaefolia*, Boulay (non Sternberg), Terr. houill. Nord France, vég. foss., p. 28, pl. 1, fig. 6.
1881. *Sphenopteris artemisiaefolioides*, Crépin in Mourlon Géol. Belg., p. 60.
1885. *Archaeopteris Sauveuri*, Stur, Carbon-flora Schatalarer Schichten, pl. XXXVI, fig. 2.
18[illegible] *Sphenopteris artemisiaefolioides*, Zeiller, Atlas, Flore foss. Valenciennes, pl. XIV, figs. 2 and 3.
1888. *Sphenopteris artemisiaefolioides*, Zeiller, Flore foss. Valenciennes, p. 132, pl. XIV, figs. 2, 3).
1388. *Cyclopteris valida*, Dawson, Geol. Hist. Pl., p. 73, fig. 23B.
1910. *Aneimites* (*Triphyllopteris*) *valida*, Dawson in Matthew, Silur. Fl., Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.
1910. *Sphenopteris artemisiaefolio[illegible]*, Crépin in Renier, Docum. l'étude Paléont. terr. houill., pl. [illegible] XII.
1911. *Cyclopteris* (*Archaeopteris*) *valida*, Dawson, Matthew, Trans. Roy. Soc. Canada, series 3, vol. 4, p. 12.

The St. John specimen was originally described by Dawson (1862 p. 319) as follows:—"Tripinnate; primary divisions of the rachis stout and wrinkled. Pinnae regularly alternate. Lower pinnules nearly as broad as long, deeply and obtusely lobed, narrowed, and decurrent at the base, regularly diminishing in size and breadth toward the point, and the last pinnules narrowly obovate and confluent with the terminal pinnule. Nerves delicate, several times dichotomous."

M. Zeiller, who has had the advantage of dealing with larger and more complete specimens than the Canadian ones, thinks that the frond was probably quadripinnate, and as he notes (1888 p. 132) the frond is characterised by the lower pinnules being pinnatifid, and the upper simple. This is seen in further Canadian examples and is illustrated in figure 22 pl. X of the present paper, and more clearly perhaps in text fig. 2.

These pinnules average about 10mm in length and the lower ones are broad and fan shaped. The latter are seen well in fig. 23,

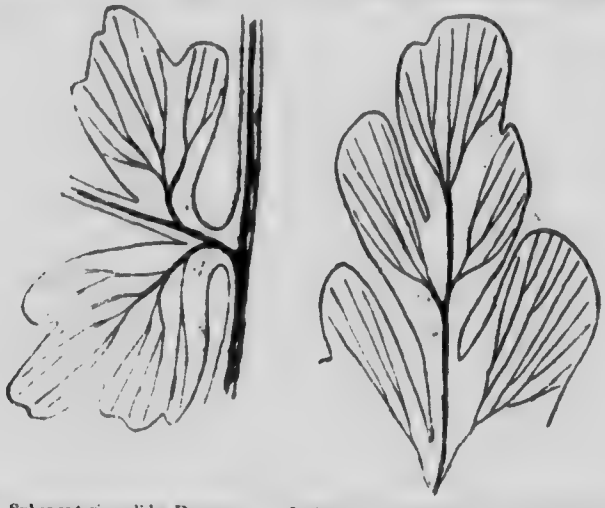

Fig 2. Sphenopteris valida, Dawson, sp. Outline of terminal and basal pinnules to show shape and venation. Enlarged.

pl. X, in a specimen I collected in 1911 at Duck cove. The termination of the leaf was not shown in Dawson's type, which was broken off, but can be seen in fig. 21, pl. IX, from another of my specimens from Duck cove. This also illustrates clearly in the highly illuminated portion, the form of the narrowing pinnules, and the confluent terminal pinnule.

The veins are uniformly distributed through the lamina, and the median nerve is barely distinguished from the others (see text fig. 2). The veins so dichotomise as to lie about 0·5 mm. apart in the lamina, and in the axis of the pinnae they follow a slightly flexuous course.

The type specimen from which Dawson's description and figure (1862 pl. XVII, fig. 52) were taken is shown in fig. 22, pl. X. It is now in the McGill University collection, No. 3327. Comparison of this with the figures of the European forms quoted in the list of synonyms above, will show that it resembles so closely the plant now known as *Sphenopteris artemisiaefolioides* Crépin as to leave little doubt as to their identity. I had the privilege of showing Dawson's original type specimen to

M. Zeiller in Paris, and there comparing it with specimens in his fine collection, which confirmed entirely his opinion that it was identical in all its characters with the European species. It will be noticed, however, that Dawson's name and description antedate the current name by many years, and must, therefore, take precedence.

In Europe the species is well known, particularly from the detailed description in Zeiller (1888), and it is a characteristic Westphalian type.

Genus CROSSOTHECA, *Zeiller.*

1883. *Crossotheca*, Zeiller, Ann. Sci. Nat., vol. 16, Bot. ser. 6, p. 180.

CROSSOTHECA (SPHENOPTERIS) HOENINGHAUSI *Brongniart* sp.

1829. *Sphenopteris Hoeninghausi*, Brongniart, Hist. végét. foss., p. 199, pl. LII.
1862. *Sphenopteris Hoeninghausi*, Brongniart, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 320.
1865. *Sphenopteris Hoeninghausi*, Brongniart, Hartt in Bailey's Rep., p. 135.
1868. *Sphenopteris Hoeninghausi*, Brongniart, Dawson, Acadian Geol., ed. 2, p. 551.
1871. *Sphenopteris Hoeninghausi*, Brongniart, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 52, pl. XVI, fig. 185.
1910. *Sphenopteris* (*Crossotheca*) *Hoeninghausi*, Brongniart, Renier, Docum. Paléont. terr. houill., pl. LXX.
1911. *Crossotheca Hoeninghausi*, Brongniart, Kidston, Végét. houill. Belge, p. 42 (for synonymy).

The only published illustration of this important species from the St. John beds, is the minute fragment figured by Dawson, 1871, pl. XVI, fig. 185. I submitted the original of this specimen to M. Zeiller, who considered that it *possibly* was *S. Hoeninghausi* but that such a specimen was really indeterminable. When in St. John, I had the privilege of seeing some of Dr. Matthew's own collection among which were larger fragments which seemed to show some of the characteristic features of this well known plant clearly enough to establish its presence. It is evident, however, that the species is, as Dawson said, "very rare" in the St. John beds.

In his account of the Pottsville, David White (1900 p. 879) applies the name *Sphenopteris asplenioides* Sternb. to this species which he records as very rare in some beds, but as having "generally a wide range in the thick sections of the Pottsville in the Southern Appalachian region." Similar forms occur also

in the Missouri Lower Coal Measures, and White (1899 p. 37, 40) describes some species which belong perhaps to "that group of Sphenopterids represented by *Sphenopteris Hoeninghausi* Brong." In Europe the plant is one of the most interesting of the Lower Coal Measure flora principally because of the discoveries of the internal structure of its stems, leaves, and fructifications. The stems are indeed the commonest of all the plants petrified in the Lower Coal Measure nodules in England, and though impressions of the foliage are scarce out of proportion to the frequency of the petrified fragments of the plant, it is one of the most important of Westphalian species and affords in itself conclusive evidence of the Carboniferous age of the beds containing it.

Genus DIPLOTHMEMA, *Stur.*

1877. *Diplothmema*, Stur, Culm-Flora 2, p. 226.

DIPLOTHMEMA SUBFURCATUM, *Dawson sp.*

Plate X, fig. 25; Plate XI, fig. 26, and text fig. 3.

1855. *Hymenophyllites furcatus*, Brongniart, Geinitz, Steinkohlform, Sachsen, p. 17, pl. XXIV, fig. 9.
1868. *Hymenophyllites sub-furcatus*, Dawson, Acadian Geol., p. 552, fig. 192N.
1871. *Hymenophyllites sub-furcatus*, Dawson, Foss. Pl. Devon. & pp. Silur. Canada, Geol. Surv. Rep., p. 53, Pl. XVI, fig. 180.
1885. *Diplothmema Zobelii*, Goeppert, Stur. Carbon-Fl. Schatzlarer Schichten, p. 332, pl. XXIX. fig. 14.
1888. *Hymerophyllites sub-furcatus*, Dawson, Geol. Hist. Pl., p. 72, fig. 22N.
1910. *Sphenopteris sub-furcatus*, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.

Dawson's material was of a very fragmentary nature, as will be seen from the drawing of his type specimen (1871, pl. XVI, fig. 180). The original of this is in the McGill University collection, No. D, and is labelled as the type in Dawson's own writing. A photograph of this specimen is shown in my pl. X, fig. 25. All the description given by Dawson (1871, p. 53) is "Similar in general form to *Sphenopteris* (*H.*) *furcatus* Brong., but with broader and acute divisions of the pinnae." From the fragmentary remains at Dawson's disposal this was indeed all that there was to be said, but the pinnules are very characteristic and easily recognised, and now the original description can be supplemented from a fine specimen in the Geological Survey collections, found by Mr. W. J. Wilson. A photograph of this

specimen is given in my plate XI, fig. 26, where the characteristic form of the leaf is clearly seen, with the dichotomous branching of the frond, and the two side branches standing at a wide angle of divergence. An outline sketch of this leaf (text fig. 3)

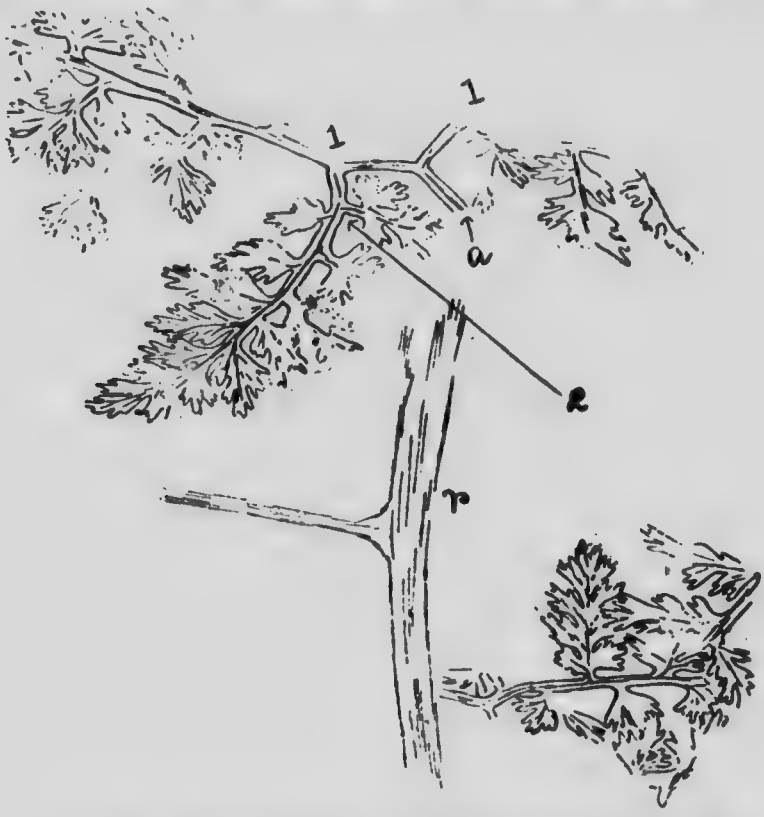

Fig. 3. Diplothmema subfurcatum, Dawson, sp. Outline sketch from the specimen represented in fig. 26, pl. XI, to show form of foliage. *r*, rachis; *a*, petiole of frond which bifurcates to segments *1* and *1*. At *2* notice that the joint lateral pinnule is towards, and parallel to, the petiole. Slightly reduced.

illustrates this in a more diagrammatic fashion. In this figure the axis *a* is seen to dichotanise suddenly and the branches 1,1 then bear *first* pinnules which turn downwards in the direction of the rachis. Comparison should be made between this figure and those illustrating Potonié's (1904, lief 2) account of *Palmatopteris*

furcata, the closely allied species so common in the European Coal Measures.

Such a comparison will render it immediately obvious that the Canadian plant and the European *furcata* are very similar forms, but the greater breadth of the pinnules and their lesser indentation in the former make them distinct species.

I found, however, on reference to the principal published figures of *H. furcatus*, that in Geinitz' (1855) account he illustrates a specimen identical with the Canadian form; this will be seen in his plate 24, fig. 9, which shows both the method of branching and the broad form of the pinnules. This plant of his obviously should not have been included in the species *furcatus* proper. In his recent account of the species Kidston (1901, p. 19) gives a list of the synonymy of *Sphenopteris furcata* Brongniart, and includes in it *Hymenophyllites furcatus* Geinitz, pl. 24, fig. 10, but excludes fig. 9 under the same name, so that it is evident he also recognised the departure of that specimen from the type of Brongniart's species. Another specimen I have noticed among those figured in Europe, and which are really identical with the Canadian form, is one of those figured as *Diplothmema Zobelii* by Stur in 1885, viz. his fig. 14, pl. XXIX. His fig. 13 on the same plate is a true example of *D. Zobelii* Goepp. sp., as he describes, but fig. 14 does not tally with the original figured by Geoppert (1836, pl. XXXVI, fig. 3) as *Hymenophyllites Zobelii*.

Consequently, the Canadian name takes precedence for these three specimens, viz. that of Dawson and the examples indicated in the works of Geinitz and Stur. There is no doubt that this form, which has been confused in Europe with *H. furcatus*, is exceedingly closely allied to it, and it may even be merely an environmental variety. It is, however, an easily recognisable variety and must, therefore, in the present state of palaeontology, take rank as a species. The form, as well as *H. furcatus*, is particularly characteristic of the *Westphalian* horizon in the European Coal Measures, and it is of special interest, therefore, to find it common in the St. John beds.

Genus OLIGOCARPIA, *Goeppert.*

1841. ***Oligocarpia***, Goeppert, Gatt. Foss. Pflanzen, lief 2, p. 3.

OLIGOCARPIA SPLENDENS, *Dawson* sp.; comb. nom.

[=*O. Brongniarti* Stur].

Plate X, figure 24, and text fig. 4.

1871. *Sphenopteris splendens*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 53, pl. XVI, fig. 186.
1885. *Oligocarpia Brongniarti*, Stur, Carbon-Fl. Schatzlarer Schichten, p. 131, pl. LVII, figs. 2, 3, text fig. 20, p. 129.
1886. *Oligocarpia Brongniarti*, Stur, Zeiller, Bassin houill, Valenciennes Atlas, pl. XI, figs. 3, 4, 5.
1888. *Oligocarpia Brongniarti*, Stur, Zeiller, Text of same, p. 97.
1910. *Sphenopteris splendens*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.

Dawson (1871, pl. XVI, fig. 186) drew only a portion of his type specimen, and from the drawings it would indeed be impossible to separate the plant from that illustrated in fig. 184 (*S. marginata*). In the actual specimens, however, both the form of the pinnules and the venation differ sufficiently to separate the two on reliable grounds.

The type specimen is No. 3315 in the McGill University collection, and is labelled as "Type" in Dawson's own writing. This is photographed in the present work, pl. X, fig. 24. An enlargement of some pinnules, showing their minutely toothed margin and the character of their veins, is given in text fig. 4.

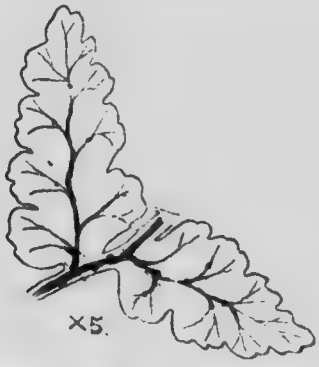

Fig. 4. Oligocarpia splendens, Dawson, sp. Outline sketch of pinnules to show veins. Note the small, hair-like structures on them.

Comparison of these illustrations with the figures published by Stur (1885) and Zeiller (1886) will render it evident that the Canadian plant is the same species. M. Zeiller on seeing the original specimen expressed himself as being in no doubt as to the identity of Dawson's type and the European form described by himself from Valenciennes.

The available Canadian material is sterile. It is in complete agreement with the detailed description given by Zeiller. On the rachis and even on the finer pinnules and veins, the "petites ponctuations éparses" mentioned by Zeiller are clearly to be seen on the specimen (see text fig. 4) and can even be recognised in the photograph if a hand lens is used.

As Dawson's name was given six years earlier than Stur's the plant should rightly go by the specific name *splendens* though it might very well be held that the species was not "recognisably illustrated" in 1871, and that, therefore, Stur's is the description to take priority. This point, which will affect a form important in [illegible]n Coal Measures, I must leave to those most af[illegible]etermine. There being, however, no doubt about the identity of the actual type specimen, and apparently none about it being the same thing as *Oligocarpia Brongniarti* Stur, I call the Canadian specimen *Oligocarpia splendens*.

Genus PECOPTERIS, *Brongniart.*

1822. *Filicites* section *Pecopteris*, Brongniart, Class Végét. Foss., p. 233.
1828. *Pecopteris*, Brongniart, Prodrome, p. 54.

The "genus" *Pecopteris* is another compound group of frond impressions resembling fern foliage, many of which were probably Pteridosperms. Species comprised in this genus by some writers are given independent generic names by others. The main characters of the form-genus are:—the fronds are tripinnate or quadripinnate, the lamina short, the pinnules distinct or confluent with rather parallel edges and attached by their whole base. The midrib is well marked, the lateral veins coming off nearly at right angles, simple, or forked.

PECOPTERIS MILTONI, *Artis*, sp.

Plate VII, figure 14–17, text figs. 5 and 6.

1825. *Filicites Miltoni*, Artis, Antediluv. Phytology, p. 14, pl. XIV (from 1838 edition).
1828. *Pecopteris Miltoni*, Brongniart, Prodrome, p. 58.
1831. *Pecopteris Miltoni*, Brongniart, Hist. Végét. Foss., p. 333, pl. CXIV.[1]
1868. *Sphenopteris pilosa*, Dawson, Acadian Geol., ed. 2, p. 552, fig. 192F.
1871. *Callipteris pilosa*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 51, pl. XVI, fig. 189.
1871. *Pecopteris* (*Cyathites?*) *densifolia*, Dawson (*non* Goeppert), Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 56, pl. XVII, figs. 195, 196.
1885. *Hawlea Miltoni*, Stur, Carbon-Fl. Schatzlarer Schichten, p. 108, pl. LIX, figs. 1-4, pl. LX.

[1] See Note p. 15

1888. *Sphenopteris pilosa*, Dawson, Geol. Hist. Pl., p. 72, fig. 22F (from 1905 edition).

1910. ?*Callipteris pilosa* and *P.* (*Cyathites*?) *densifolia*, Dawson, Matthew, Nat. Hist. Soc. New Brunswick, vol. 6, pp. 248, 249.

For complete synonymy of *P. Miltoni* see Kidston, 1911, p. 50.

The two fragments of foliage described as *Callipteris pilosa* and *Pecopteris densifolia* cannot retain rank as separate species, for they can be matched on different portions of a single leaf when one has larger specimens with which to compare them. The type specimen of Dawson's species *Callipteris pilosa* is in the British Museum collection (V 693) and was sent by him to the Museum as an exchange in 1884. The specimen is not labelled as the type, but comparison of the specimen with Dawson's figure 189, Pl. XVI, in his 1871 report, leaves no room to doubt that his drawing was made from it. (Cf. fig. 14, pl. VII in the present paper.) This specimen has a small printed label of Dawson's with "*Sphenopteris pilosa*" followed by "Erian, St. John" in his handwriting. A second specimen (V 4480) with an identical small printed label has the "*Spheno*" struck through and "*Calli*" written over it. Other specimens of *C. pilosa* are in the St. John Natural History Museum, one of which is shown in fig. 15, pl. VII, of the present paper.

As regards *P. densifolia* of Dawson. The original of his fig. 195, pl. XVII, in the 1871 monograph, which is the type specimen, is in the McGill University collection labelled as "Type 1" by Sir W. Dawson. A photograph of this is given in my pl. VII, fig. 16. It may be at first difficult to recognise that this is really the specimen from which Dawson drew his figure, but the two pinnules marked "X" are those he figured. The original of the second illustration (his fig. 196) is now in the British Museum, V 688. It was sent in a collection of St. John plants in 1884, and is labelled in Sir William Dawson's writing as "Type 2." This is an exceedingly obscure and highly graphitized example, as will be seen from fig. 17, pl. VII, in the present paper. Indeed, from the photograph it is almost impossible to recognise that it is really the original of his fig. 196, pl. XVII, but the comparison of the actual specimen and his drawing prove that that is the case. Not one of these specimens is in a really satisfactory state of preservation, and it was only

after comparing them bit by bit with the relatively complete fronds of *P. Miltoni* in Paris which M. Zeiller kindly showed me, that it became evident that they were all variously disintegrated fragments of this species. For help with this unsatisfactory material I am particularly indebted to M. Zeiller, who showed me one fine specimen of *P. Miltoni* with *"Callipteris pilosa"* pinnules low down on the frond and *"Pecopteris densifolia"* pinnules at the top.

Reference should be made to Fig. 1 on pl. XL of Stur's (1885) monograph for comparison with the fragment from St. John illustrated in pl. VII, figs. 14 and 15. An outline sketch of one of these is given in text fig. 5, and as much as is possible of the venation in text fig. 6. From the photograph, fig. 14, alone it might appear that the plant differs a good deal from *P. Miltoni*, but this specimen is in a curious state of preservation and has been slightly "smeared" by movement in the matrix. The actual specimen bears detailed comparison with Stur's illustrations.

FIG. 5

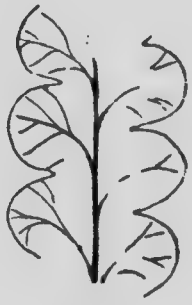

FIG. 6

Fig. 5. Pecopteris Miltoni. Outline sketch of the specimen represented in fig. 15, pl. VII, to show shape of pinnules.
Fig. 6. Enlargement of a St. John pinnule to show that the character of the venation agrees with P. Miltoni, so far as it is preserved.

In 1874 (p. 496) Schimper commented on Dawson's plant: "La fig. 196 de la même planche (XVII) citée par Dawson comme appartenant à cette espèce, a les pinnules dentées et me paraît se rapporter au *P. serrulata*." But as will be recognised on comparison with the photographs, Dawson's drawing did not really bring out the true features of the plant, and the dentations of the margin in fig. 196 are very much exaggerated.

In his account of the Pottsville, David White (1900) quotes both *P. Miltoni* and *S. pilosa* Dawson as occurring in several of the beds. He gives no description of either, however, and does not appear to have noticed their similarity. Speaking of *Sphenopteris pilosa* Dawson (p. 883), White says:—"The specimens, including the types, from the upper portion of the Pottsville in Washington County, Arkansas, described by Lesquereux (Coal Flora, vol. III, p. 762, pl. CII, figs. 1, 1a) as *Sphenopteris communis*, appear to present the identical specific characters seen in examples of *Sphenopteris pilosa* from the so-called middle Devonian beds at St. John, New Brunswick." As I have not seen any of the actual specimens of Lesquereux's species, I cannot express any opinion on this conclusion beyond the remark that it seems to be, naturally, largely dependent on Dawson's descriptions and figures of his specimens—the value of which the photographs accompanying the present paper enable one to form an impartial judgment.

Pecopteris plumosa, *Artis sp.*

Plate XII, figures 27, 28, 29, and text fig. 7.

1825. *Filicites plumosus*, Artis, Antediluvian Phytology, p. 17, pl. XVII (Ed. 2, 1838).

1836. *Pecopteris plumosa*, Brongniart, Hist. vég. foss., p. 348, pl. CXXI CXXII.

1862. *Neuropteris serrulata*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 320, pl. XV, fig. 35*a*, *b*.

1868. *Pecopteris* (*Alethopteris*) *serrulata*, Hartt in Dawson, Acadian Geol., p. 553, fig. 192K.

1871. *Pecopteris* (*Aspidites*?) *serrulata*, Hartt in Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 55, pl. XVIII, figs. 207–209.

1871. *Neuropteris serrulata*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 49, pl. XVIII, fig. 213.

1882. *Pecopteris* (*Aspidites*?) *serrulata*, Hartt, Dawson, Foss. Pl. Erian Upp. Silur. Canada, Geol. Surv. Rep., pt. 2, p. 117.

1885. *Senftenbergia plumosa*, Stur, Carbon-Fl. Schatzlarer Schichten, p. 92, pl. LI, figs. 1, 2, 3.
1888. *Pecopteris serrulata*, Hartt, in Dawson, Geol. Hist Pl., p. 73, fig. 23K (in 1905 edition).
1897. *Dactylotheca plumosa*, Kidston, Foss. Fl. Yorkshire Coalfield, Trans. Roy. Soc. Edin., vol. 38, p. 205, pls. I–III.
1910. *Pecopteris plumosa*, Seward, Fossil Plants, p. 404.
1910. *Pecopteris* (*Dactylotheca*) *plumosa*, Artis, Renier, Docum. Étude. Paléont. terr. houill., pls. LXXXVI, LXXXVII.
1910. *Pecopteris* (*Aspidites*) *serrulata*, Hartt, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.

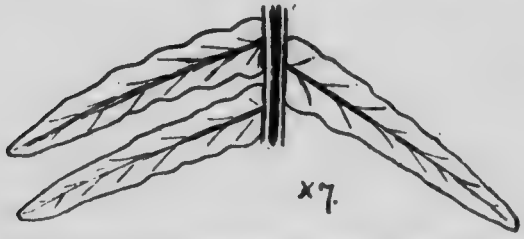

Fig. 7. Pecopteris plumosa, Artis. Enlargement of pinnules from St. John specimen.

Dawson (1871, p. 49) says: "This species was founded upon a few fragments from Carlton, and Mr. Hartt subsequently discovered more perfect specimens, which seemed to him to indicate that the species is really a *Pecopteris*. In this conclusion I acquiesced, and omitted this species from the list in Acadian Geology. Subsequently, however, I found, on comparing the specimens in Mr. Hartt's collection with those I had previously obtained, that there are two species, for one of which I retain the name *Neuropteris serrulata*." As will be seen from his illustrations of this "species" he was handicapped by having such very small and imperfect fragments with which to deal. Two hand specimens of a few pinnules taken from different parts of a leaf may appear sufficiently unlike each other to justify the foundation of two species to contain them, when, had a more complete specimen of the leaf been available it would at once be seen that they both came from it, only from different levels of the frond. Even the "more perfect specimens" Dawson had to work on later were really very small portions of the leaf, as will be seen on reference to my plate XII, figs. 27, 28, 29, where are photographed the specimens now in McGill University

collection, No. 3316, given by Sir W. Dawson. The suggestion that the St. John beds contained the well-known European *Pecopteris plumosa* was made long ago by Geinitz (1866), when he remarked that the supposed Devonian insects were on a specimen containing *Pecopteris plumosa* "welches Vorkommen dafür sprechen dürfte, dass dieser Schiefer der Steinkohlen formation selbst, nicht der Devon formation, angehört." Dawson (1882, p. 115) did not reply to this till 1882, when, however, he merely reiterates his own view that the plant comes from beds that he had proved to be Devonian, and though he acknowledges that the plant is like *P. plumosa*, he continues to consider the two as distinct species.

I took the Canadian specimens to Paris and there, through the kindness of M. Zeiller, was able point by point to compare them with true specimens of *P. plumosa*. In different parts of the leaves of this European species the Canadian ones could be matched entirely, and there seems not the smallest doubt that the plants from St. John are simply *Pecopteris plumosa*.

An important work on the species was published by Kidston (1897), to which reference should be made. He notes how variable the frond is, and illustrates a number of the different forms taken by the leaflets. Seward (1910, p. 404), also gives a valuable abridged account of the plant.

The species is widely distributed in the Westphalian, and is particularly common in the Middle Coal Measures of Britain.

Genus ALETHOPTERIS, *Sternberg*.

1826. *Alethopteris*, Sternberg, Versuch Fl. Vorwelt, p. xxi.

This genus is founded for the impressions of compound fernlike foliage. The leaves are large and tripinnate, the pinnules simple and undivided, thick, and usually oblong, and inserted on the rachis with a broad base, generally decurrent on the lower side and sometimes confluent from leaflet to leaflet. The median nerve is well-marked and extends the whole length of the pinnule, and on the lower side of the pinnule is generally prominent. The secondary nerves are simple, branching from the mid-rib at a wide angle, and running straight to the edge or dichotomising once; they are generally fine and close together.

Fertile segments with fern-like sporangia have never been found, which suggested to Stur that the plant was not a true fern. No seeds have been found in organic connexion with any part of the foliage, but impressions are constantly associated and Scott's results with structural material make strongly in favour of the presumption that *Trigonocarpum* is the seed of *Alethopteris*, while it has been established that the internal anatomy of the petioles was that of a *Medullosa*. The plant, therefore, certainly belongs to the recently founded group of Pteridospermae. (See Oliver and Scott, 1904.)

ALETHOPTERIS LONCHITICA, *Schlotheim* sp.

[=*Alethopteris discrepans*, Dawson.]

Plate XII, figure 30; Plate XIII, 31, 32, 33; Plate XVIII, figure 46; Plate XXII, figure 57*a*; text fig. 8.

1804. Cf. *Polypodium* vel *Lonchitis*, Schlotheim, Flora Vorwelt, p. 55, pl. XI, fig. 22.
1820. *Filicites lonchiticus*, Schlotheim, Petrefactenkunde, p. 411.
1833. *Pecopteris lonchitica*, Brongniart, Hist. Végét. Foss., p. 275, pl. LXXXIV, figs. 1–7.[1]
1862. *Pecopteris* (*Alethopteris*) *decurrens*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 322, pl. XV, fig. 40a, b, c.
1865. *Alethopteris discrepans*, Dawson, Hartt in Bailey's Report, p. 136 and p. 137.
1868. *Alethopteris discrepans*, Dawson, Acadian Geology, p. 552, fig. 192I.
1871. *Alethopteris discrepans*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 54, pl. XVIII, figs. 203–205.
1886. *Alethopteris lonchitica*, Schlotheim sp. Zeiller, Bassin houill, Valenciennes, Atlas, pl. XXXI, fig. 1.
1888. *Alethopteris lonchitica*, Schlotheim sp. Zeiller, Text of same, p. 225.
1888. *Alethopteris discrepans*, Dawson, Geol. Hist. Pl., p. 73, fig. 23I (from 1905 edition).
1900. *Alethopteris discrepans*, Dawson, Kidston in Ami, Ottawa Nat., vol. 14, p. 100.
1910. *Johannophyton discrepans*, including *Sporangites acuminatus*, Dawson, Matthew, Trans. Roy. Soc. Canada, vol. 3, p. 83, pl. II, figs. 7–9, pl. III, figs. 1–10.
1910. *Johannophyton discrepans*, Dawson sp., Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.
1910. *Alethopteris lonchitica* (Schlotheim), Renier, Docum. l'Étude Paléont., pl. XCII.

[1] See note p. 15.

In the first place, Canadian specimens were described as "*Pecopteris* (*Alethopteris*) *decurrens*" sp. nov. by Dawson, but in all Dawson's later descriptions he used the name *discrepans*. No reference was made to *A. decurrens* of Artis, so it is probable that Dawson had overlooked that species. In the Geological Society's Journal (1863) Dawson says "I desire to change the name *Pecopteris* (*Alethopteris*) *decurrens*, of my last paper, into *P. discrepans*,—a species from the coal of Pennsylvania having been described by Lesquereux under the former name."

The St. John plants appear to agree in every particular with specimens of the well-known *Alethopteris lonchitica* Schl. as comparison with the illustrations provided in this paper with those of the European examples will prove. There are, however, several points about which some comment may be useful. The species *discrepans* has been considered a good one by several writers, Kidston, White, and Matthew, for instance, all quote it. As Dr. Kidston identified some specimens under the name *A. discrepans* from some Canadian deposits (see Kidston in Ami, 1900, p. 100), I enquired of him why he had kept the name *discrepans* for a species that seemed to me to be identical with *A. lonchitica*. Dr. Kidston kindly replied by letter saying of Dawson's 1871 pl. XVIII, fig. 204, "I can see no difference in form or arrangement of midrib from *A. lonchitica*. Fig. 203 is a very broad form for *A. lonchitica*. Fig. 205 might be anything. The enlarged drawing of the nervation, especially 204a, is far too distant as shown on my fragment of *A. discrepans*," but he declined to express an opinion as to whether "*A. discrepans*" and *A. lonchitica* were the same thing. On the other hand, Dr. Matthew of St. John vigorously supports not only the distinction between the two species, but the fact that the "*discrepans*" form is a good zone fossil indicative of the "Silurian" beds ("Devonian" of Dawson) of the St. John Fern Ledges. After going thoroughly into the matter, it appears to me that Dr. Matthew's criterion of distinction between the two species is merely the fact that in "*discrepans*" there is always a small space between the decurrent wing of one pinnule and the upper blade of the next below it, coupled with an asymmetric disposal of the mid-rib such as is clearly seen in the diagram, text fig. 8. Matthew (1910A, p. 84) says: "I have never found

the pinnules connect, there is always a short bare space on the rachis." He was even more emphatic in our conversations on this point.

Fig. 8. Alethopteris lonchitica, Schlotheim, sp. *A*, tracing from Dawson's specimen of "A. discrepans" (fig. 30, pl. XII); *B*, tracing of Alethopteris lonchitica in Renier's pl. XCII; *C*, Alethopteris lonchitica from specimen I found at Joggins, Nova Scotia. In each case the asymmetrically placed midrib is evident, and the "discontinuous" decurrent bases of the pinnules.

Now it will here perhaps be best to quote verbatim Sir William Dawson's original account, which is the most complete he gave, and which supplied the diagnosis for his later references. (Dawson, 1862, p. 322). "Bipinnate. Pinnules rather loosely placed on the secondary rachis, but *connected by their decurrent lower sides*, which form a sort of margin to the rachis. Midrib of each pinnule springing from its upper margin and

proceeding obliquely to the middle Nerves very fine and once-forked. Terminal leaflet broad. This fern so closely resembles *Pecopteris Serlii* and *P. lonchitica* that I should have been disposed to refer it to one or other of these species, but for the characters above stated, which appear to be constant. *P. Serlii* is abundant in the Lower Carboniferous of northern New Brunswick, and *P. lonchitica* is the most common Fern throughout the whole thickness of the Joggins Coal Measures; but in neither locality does the fern found at St. John occur. On this account I think it probable that the two are really distinct. In Murchinson's Siluria 2nd Edition p. 521 a fern from Coalbrook Dale is figured as *P. lonchitica*, which, so far as one can judge from the engraving, may be identical with the present species. Locality, St. John." It will be seen how far from dogmatic about its separation from *A. lonchitica* Dawson was in this original account of his St. John plant. The specimen figured by Murchison is among his Carboniferous fossils, so it is obvious from the concluding sentence of Dawson, quoted above, that he was inclined to believe his plant the same as the Carboniferous form.

It will be seen from the above description that the principal character on which stress is now laid by Dr. Matthew, viz., the *dis*-continuance of the decurrent bases, is absolutely opposed to one of the main features given in Dawson's diagnosis of the type, viz, the connexion between the decurrent lower sides "to form a sort of margin to the rachis." Those who would uphold the difference of "*discrepans*" from *lonchitica* and its character as a St. John zone fossil, are thus placed in a dilemma. They must either give up the last remaining character by which they separate "*discrepans*" from the Coal Measures forms, when they must merge it with *lonchitica*; or they must reject the decurrent continuous bases described and figured by Dawson and look on them as fantasmal.

But the valuelessness of this point as a character on which to base specific distinction is immediately apparent on turning over the principal figures of the European *A. lonchitica* (for references see Kidston, 1911, p. 62) where both varieties are about equally numerous. Furthermore, in large specimens, e.g. in the Paris collections, one can find the continuous and discontinuous bases in different portions of the same specimen.

As so much stress has been laid on the discontinuous form as being confined to the Little River deposits, while I was in the field I took particular interest in the matter, and made a special journey to the Joggins Carboniferous section (acknowledged by the whole world to be a typical Coal Measure series) to seek for the plant there. I was quickly rewarded by finding innumerable fragments of "*discrepans*" with the discontinuous leaf bases. Some of these fragments had broad leaflets like the larger St. John "discrepans" (cf. my fig. 32, pl. XIII, and some of the smaller type, see my fig. 33, pl. XIII. Compare this last with Dawson's 1871 pl. XVIII, fig. 205, which was refigured by Matthew, 1910A, pl. III, fig. 3). More protracted search would doubtless be rewarded by larger and more perfect leaves, but the numerous fragments I found in two days indicated that the form is as common in the Joggins Coal Measures as it is in the Little River beds of St. John.

The a-symmetrically placed vein again, has been brought forward as a character in which "*discrepans*" differs from *A. lonchitica*. But reference to Renier's admirable plate 92 (Renier 1910) will at once dispel that illusion. Indeed, the fragments shown in Renier's plate and that photographed (one of Dawson's own specimens) in my pl. XII, fig. 30 are so absolutely identical as finally to clinch the proof that "*A. discrepans*" is *A. lonchitica*. The outline diagrams, text fig. 8 of the three plants, will illustrate this. The first is an outline from Dawson's specimen of "*discrepans*," the second is traced from Renier's plate of *A. lonchitica*, and the third is from a specimen I found at Joggins. They are self-evidently the same thing. After I had reached, by the reasoning outlined above, and my experience in the field, the above conclusion, I accidently came across a footnote by Dr. Jongmanns in his valuable work on the *Calamites*. Jongmanns (1911, p. 374) says "Matthew's *Johannophyton* n. gen. *discrepans* ist einfach *Alethopteris lonchitica*."

Having, therefore, demonstrated the identity of the plant with the well-known and widely distributed European form, there is no need to be at pains to point out why Matthew's new genus "Johannophyton" cannot stand. Something must be said, however, about the fructification attributed by Dr. Matthew to the plant.

Matthew (1910A p. 85) says: "In several examples which I have seen, this rachis becomes entirely devoid of pinnules and extends into a long slender peduncle, garnished at distant intervals by groups of the bracts of *Sporangites acuminatus* Dn. We thus seem to have this fossil connected to *Alethopteris discrepans* as its fruiting portion." Matthew goes on to state "on the surfaces where they occur the pinnules of *Alethopteris discrepans* are invariably present."

When I was in St. John Dr. Matthew kindly showed me the original specimens from which he drew these conclusions, and much as I regret to add this to the many points on which we disagree, I must state that while it seems possible that *Sporangites acuminatus* were attached to slender stalks, I saw no absolute proof of this and no evidence at all conclusive that any slender stalks—let alone *Sporangites*-bearing stalks—were organically a part of *A. "discrepans."*

In my fig. 46 pl. XVIII, is shewn a slab of a number of minute fragments such as are commonly found together, and there, separate fine stalks, leaflets of *A. "discrepans,"* and *Sporangites acuminata* (see p. 73 following) are all near each other in space, but organically disconnected. Which I believe to be their true relation.

Dr. Matthew considers that *S. acuminata* contained small seeds. This is possible (see p. 74) but from the material available it is difficult to determine whether this is the case. If it were so, it hardly seems likely that the number he gives, viz: 3 seeds, will be found to be enclosed in this 5 lobed "cupule."

An alternative proposition, that *S. acuminata* may be the male fructification of some pteridosperm has, at any rate, nearly as much to recommend it as the former view.

To return to *Alethopteris*. Scott (1909, p. 427) says of its foliage impressions, "there is now good evidence that they belonged to stems of the family of Medulloseae, of which the structural characters are known." Dr. Scott elaborates the evidence from petrified material, and (p. 456) continues "the presumption is entirely in favour of this seed (*Trigonocarpum*) being the fructification of the *Alethopteris* (probably *A. lonchitica*) which formed the foliage *of Medullosa anglica.*" *Trigonocarpum* is a genus of stony, cycad-like three ribbed seeds. The species vary, but all

are unusually large, *T. Parkinsoni*, for instance, measuring as much as 5 cm in length. This makes it impossible for the minute valves of "*Sporangites*," which measure only 4-5 mm in length to be the cupule of any of the Trigonocarpums. Consequently, in consideration of the sound evidence in favour of the view that *Trigonocarpum* is the seed of *Alethopteris*, it is impossible to imagine *Sporangites* in any form in the role of female fructification of the group. If, therefore, Dr. Matthew should be right about the *Sporangites* segments containing seeds, that would tend to disprove his presumption that they belong to *Alethopteris* "*discrepans*." On the other hand, if he is right about their association with the plant, then they can only represent the male fructifications. They do not seem to bear any resemblance to the male organs of any other Pteridosperm of which these parts are known, so that it is difficult to express an opinion on the subject. I, therefore, describe them separately under Dawson's name (see p. 73) with the reservation that association (a most dangerous criterion in many cases) with *A. lonchitica* in a number of slabs may suggest the possibility that they are its male organs.

Genus MEGALOPTERIS, *Dawson*.

1871. *Neuropteris* (*Megalopteris*), Dawson, Foss. Pl. Devon. Upp. Silur., Geol. Surv. Rep., p. 51.
1875. *Megalopteris*, Dawson, Andrews, Rep. Geol. Surv. Ohio, pt. 2, p. 415.

The genus is characterised by simple pinnate fronds, irregularly branching, with long, strap-like, decurrent pinnules. The nervation resembles that of a *Neuropteris*, and the veins dichotomise several times on their curved course to the margin. White (1899, p. 129) says of the genus "*Megalopteris*, while possibly less ancient than certain of the early Callipteridioid *Neuropteris* species, may, nevertheless, be taken as an example of the archaic composite type of Neuro-Alethopteroid fern life."

MEGALOPTERIS DAWSONI, *Hartt* in Dawson.

Plate XIII, figure 34.

1865. *Neuropteris*, Sp. nov. Hartt, in Bailey's Report, Append. A., p. 137.
1868. *Neuropteris Dawsoni*, Hartt, Dawson, Acadian Geol., p. 551, fig. 193.
1871. *Neuropteris* (*Megalopteris*) *Dawsoni*, Hartt, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 51, pl. XVII, figs. 191–194.

1888. *Megalopteris Dawsoni*, Hartt, Dawson, Geol. Hist. Pl., p. 76, fig. 26 (1905 edition).
1910. *Megalopteris Dawsoni*, Hartt, sp. Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.

In his Acadian Geology, p. 551, where this species was first published, Sir William Dawson quotes the description from Hartt. It is a comparatively full description, much more complete than the casual mention of a new *Neuropteris* which is given by Hartt in Bailey's report and which appears to be all that Hartt actually published himself about the plant. In this report, Hartt mentions his intention to publish a monograph on these fossil beds of St. John, but died without accomplishing that (see his life in Rathbun's paper, 1878). It is, therefore, probable that Sir William Dawson in 1868 was quoting from the manuscript of Hartt's projected work.

The plant was later defined (1871) and further described and illustrated by Dawson, who notes that the mode of branching of the long pinnules is different from that of a true *Neuropteris*, and he suggests the sub-genus *Megalopteris* which was adopted as the generic name by later writers. A photograph of the McGill specimen, No. 3326, is shown in the present paper, pl. XIII, fig. 34. This shows at *b* the branching off of two large, almost equal pinnules each with a stout mid-rib from which the veins spray off in a curved direction to the simple margin. The appearance of large irregular dentation is simply due to the broken edge of the specimen. Andrews (1875, p. 415) describes several species of *Megalopteris* from the base of the Coal Measures in Ohio. He states (p. 416) "The Ohio species are of rare interest, not only for the beauty of the plants, but because they are found, not in the Devonian, but in the Coal Measures. Between them and any Ohio Devonian rocks are the Maxville limestone (equivalent of the Chester, Illinois, group) and the Lower Carboniferous Waverley sandstone group." Andrews' specimens are also of particular value, as some are sufficiently complete to show the branching character of the fronds (this is reproduced in Zeiller, 1900, p. 111, text fig. 85).

It should be noticed that Dr. Matthew made the discovery of this genus by Andrews in Ohio, the basis for an argument to bolster up his view that the St. John's plants are pre-Carboniferous. But as Mr. David White pointed out (1902, p. 233)

the Ohio beds are now well known to be of Pottsville age, and the genus has not yet been found in any earlier deposit.

In his account of the Pottsville of the United States, David White (1900, p. 887) records a new species *M. plumosa*, which he describes as closely resembling *M. Dawsoni*, and he states "The species of the rare genus *Megalopteris*, including the *Megalopteris Dawsoni* described from St. John, New Brunswick, appear to be characteristic of the Pottsville formation." Seward and Leslie (1908, p. 114) consider that this is very like a South African plant *Glossopteris augustifolia* Brongn. var. *taeniopteroides* Sew. and Leslie, except in the cross connexions between the veins, which are not present in the Canadian fossil. Dawson himself noticed a resemblance between *Glossopteris* and his Canadian plant, but there does not appear to be any evidence that the superficial similarity is an indication of a profound affinity.

Arber (1905, p. 307) records a fragment which Dr. Kidston suggests should be compared with Dawson's *Megalopteris*. This is from the so-called "Culm (Upper Carboniferous) of Devon, but is too incomplete to be of value in a comparison of the European and American floras.

The species of *Megalopteris* are all very similar, and the genus is one of the most characteristic and easily recognised of the St. John plants. Its presence in the Fern Ledges is one of the strongest arguments for associating them with the American Pottsville.

Genus ADIANTIDES, *Schimper.*

1869. ***Adiantides***, Schimper (***Adiantites*** Auct.), Traité, vol. 1, p. 424. Ref. Stur, Culm. Flora, p. 65.

Seward (1910, p. 376) notes that this generic name was first applied to *Ginkgo*, and that it bears an unwarrantable suggestion of likeness to *Adiantum*. It is certainly far from a satisfactory generic name. The forms described under it, however, have a very characteristic appearance, and form a good genus in all probability. It is defined by Stur as follows:—"Folia indivisa, vel. 1-5 pinnatisecta; segmenta ultima suborbicularia, aut obovato-cuneata, et longe-traingulari-cuneata, plus minus inaequilatera; nervatio Cyclopteridis, nervis, crebris flabellatofurcatis vel dichotomis." I do not feel myself justi-

fied in re-naming this genus of plants, however unsatisfactory is the name *Adiantides*.

Adiantides obtusus (*Dawson*) sp.

Plate XVI, figure 42.

1858. *Noeggerathia Bockschiana*, Lesquereux, Rogers Pennsylvania Rep., p. 854, pl. III, fig. 1.
1862. *Cyclopteris obtusa* Lesquereux, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 319, pl. XV, fig. 33.
1865. *Cyclopteris obtusa Lesquereux*, Hartt in Bailey's Rep., p. 135.
1868. *Cyclopteris obtusa*, Lesquereux, Dawson, Acadian Geol., p. 547.
1868. *Cyclopteris Bockshiana*, Goeppert, Dawson, Acadian Geol., p. 549.
1871. *Cyclopteris (Aneimites) obtusa*, Lesquereux, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 46, pl. XVI, fig. 188.
1871. *Cyclopteris (Aneimites) Bockshii*, Goeppert, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 46, pl. XVI, fig. 187.
1879–80. *Archaeopteris Bockschiana* ?, Goeppert, Lesquereux, Coal Flora, p. 306, pl. XLIX, figs. 1–4.
1882. *Aneimites obtusa*, Dawson, Foss. Pl. Erian Upp. Silur. Canada, pt. 2, p. 101.
1888. *Aneimites obtusa*, Dawson, Geol. Hist. Pl., p. 72, fig. 22A (from 1905 edition).

About the identity of the actual plant which is best known as *Aneimites obtusa* Dawson, there is no doubt, for the specimen in the McGill University collection, No. 3323, is clearly the original from which Dawson drew his fig. 188 pl. XVI, in his 1871 monograph. A photograph of this specimen is given in my pl. XVI, fig. 42. Nevertheless, about the nomenclature there has been considerable confusion. In his original description in 1862 Dawson (p. 319) allocated his plant to "*Cyclopteris obtusa* Lesquereux." But reference to Lesquereux's species, described in Roger's report on Pennsylvania, 1858, shows that it was the species *Bockschiana* (pl. III, fig. 1) and not *obtusa* which was the same as the Canadian form. In 1868 Dawson in his "Acadian Geology" p. 549 identified a fragment as *C. Bockschiana* Goeppert, but said that he thought it possible that the fragment was the same as *C. obtusa*. In the 1871 monograph, Dawson does not re-describe the plant *C. obtusa* though he gives another and more complete figure, and merely in a line refers to the original incorrect reference to Roger's report.

Schimper in 1874 in his vol. 3, p. 485, discusses these species and points out Dawson's confusion, with resulted in 1882, in Dawson re-naming his plant as *Aneimites obtusa* which name he perpetuated in 1888.

Under the present definition of the genus *Aneimites* however the plant cannot be included, even were the genus a satisfactory one. But, as Seward (1910 p. 346) says "The generic name *Aneimites* proposed by Dawson for some Devonian Canadian plants resembling species of the recent genus *Aneimia*, and adopted by White for a species from the Pottsville beds of Virginia, is misleading. The Canadian plants give no indication of the nature of the reproductive organs, and the fronds described by White are, as he shows, those of a Pteridosperm and bore seeds." M. Zeiller drew my attention to what he thought might be the identity of this Canadian plant with *Cyclopteris adiantopteris* Weiss, figured by Potonié (1893, pl. II, fig. 3, p. 7). The likeness between the plants is remarkable, leaving no doubt that they are very closely allied species if they are not actually the same. It appears to me, however, that it is better to keep the Canadian plant separate for the present because it is not possible entirely to establish its identity with this European form. There are two main differences between them, they are:— (1) The veins are thicker and more strongly marked in the European specimen than in the Canadian. This may be due to the compressed condition of the plants in the slaty like St. John shales, but judging from the only available material it is a distinct difference. (2) The Canadian plant shows the lax, irregular disposal of the pinnules and gives some indication of the relations of the pinnae. This feature is not shown in the European plant, and in the portion to the right of the figure 3*a* it suggests a larger, more regular and compact arrangement. I fully recognise, of course, that these differences are no more than are to be found in any tri-pinnate leaf between its upper and lower segments, but until larger and more complete specimens are available to prove the identity of the two plants, I think it more scientific to keep the Canadian plant under a name of its own.

I feel constrained to follow Dr. Jongman's advice, given in conversation in the British Museum over the original specimen, and place it in the genus *Adiantides* as described by Stur (1875 p. 65) little as I like the generic name, and certain as I am that some day it will be superceded. There is considerable similarity between the Canadian form and *A. antiquus* Ett. sp. particularly

as figured by Stur (1875 pl. XVI, figs. 4, 5). Kidston (1889 p. 421 pl. I, fig. 1) figures a specimen in the British Museum Geological Department (V 1761) with which the Canadian specimen has some similarity, but the pinnules of the latter are rather larger and more rounded, and are all entire (so far as the evidence available indicates) instead of splitting as do the pinnules of *A. antiquus*.

Genus NEUROPTERIS, *Brongniart.*

1822. *Filicites*, section *Neuropteris*, Brongniart, Class. Végét. Foss., p. 233.

The impressions of foliage included in this genus are probably almost all Pteridosperms. The most important species, *Neuropteris heterophylla* was discovered by Kidston (1904) in organic continuity with a large seed. For an account of the important bearing of such results on botanical morphology reference should be made to Scott's "Studies" and Kidston's recent account (1911 p. 71) of the genus. The fronds generally dichotomise, and are of large size, aphlebiae are characteristic. In the compound leaves the terminal pinnule of each pinna is generally the largest, often markedly so; the pinnules are entire and appear leathery or stout. There is no single well marked mid-rib, though in some species an aggregate of veins running centrally for some way, much resembles one. The veins follow a more or less arched course, and frequently dichotomise.

NEUROPTERIS HETEROPHYLLA, *Brongniart.*

[=*Neuropteris polymorpha* Dawson].

Plate XIV, figure 35; Plate XV, figures 36, 38; Plate XXI, figure 56; and text figs. 9 and 10.

1822. *Filicites* (*Neuropteris*) *heterophyllus*, Brongniart, Classif. Distrib. Végét. foss., p. 233, pl. XIII (ii), figs. 6*a* and *b*.
1831. *Neuropteris heterophylla*, Brongniart, Hist. Végét. Foss., p. 243, pl. LXXI, LXXII, fig. 2.[1]
1862. *Neuropteris polymorpha*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 320, pl. XV, figs. 36, *a*, *b*, *c*.
1868. *Neuropteris polymorpha*, Dawson, Acadian Geol., ed. 2, p. 549, fig. 192c.
1871. *Neuropteris polymorpha*, Dawson, Foss. Pl. Devon Upp. Silur. Canada, Rep. Geol. Surv., p. 49, pl. XVIII, fig. 212. —?
1886. *Neuropteris heterophylla*, Brongniart, Zeiller, Bassin houill, Valenciennes Atlas, pl. XLVIII, figs. 1, 2; pl. XLIV, fig. 1.
1888. *Neuropteris heterophylla*, Brongniart, Zeiller, Text of Same, p. 261.
1888. *Neuropteris polymorpha*, Dawson, Geol. Hist. Pl., p. 72, fig. 22c (from 1905 edition).

[1] See note p. 15.

1910. *Neuropteris polymorpha*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.

1910. *Neuropteris heterophylla*, Brongniart, Renier, Docum. l'Étude Paléont. terr. houill., pl. XCIX.

(For complete synonymy of *N. heterophylla* see Kidston, 1911, p. 75.)

FIG. 9

FIG. 10

Fig. 9. Neuropteris heterophylla, Brongniart. Outline tracing of Dawson's specimen of "N. polymorpha" (see fig. 25, pl. XIV).

Fig. 10. Neuropteris heterophylla, Brongniart. One of the terminal pinnules of Dawson's "N. polymorpha," enlarged to show the venation.

The drawings given by Dawson in his first account of the St. John *Neuropteris* are very incomplete, and we must turn to the fig. 212, pl. XVIII, in his 1871 monograph for a sketch of what is the most characteristic specimen obtained from the St. John beds. This specimen is in the McGill University collection, No. 3311, and is by far the most perfect obtained from the locality, though smaller portions and isolated pinnules are frequent. It is shown in fig. 35, pl. XIV, of the present paper, and in the outline sketch text fig. 9. A single pinnule is enlarged to show the veins in text fig. 10. Dawson's description (1862, p. 320, and 1871, p. 49) is as follows:—"Pinnate or bipinnate. Rachis or secondary rachis irregularly striate. Pinnules varying from round to oblong, unequally cordate at base, varying from obtuse to acute. Terminal leaflet ovate, acute, angulated or lobed. Midrib, delicate, evanescent. Nervures slightly arcuate, at acute angles with the midrib." To this in 1862 he added: "In its variety of forms it resembles *N. heterophylla* Brongn., or *N. hirsuta* Lesquereux; but it differs from the former in its delicate midrib, and acutely angled nervures, and from the latter in its smooth surface." This was written before many of the most important works on Coal Measure plants were published, but now that they are available reference should be made to the leading illustrations of *N. heterophylla* when the remarkable resemblance, amounting to identity of the Canadian and European plants, will be observed. At M. Zeiller's suggestion, I took Dawson's specimen with me to Paris, and on comparing it with specimens of Westphalian age, there remained no doubt that the Canadian plant is simply *N. heterophylla*. The terminal pinnule, which is rather pointed, may at first suggest that the form is a local variety, but a specimen from the Paris collection labelled "Mines d'Anzin, Etage, Westphalien No. V, 520" is identical with the Canadian form in these particulars. Prof. Zeiller kindly lent me the specimen to photograph. This is shown in fig. 36, pl. XV, of the present paper, so that it is possible for the reader to compare the two plants.

The Canadian specimens are all sterile foliage, and the majority of them are fragmentary. Separated from the rachis innumerable pinnules occur on the slates with other plants (see fig. 56, pl. XXI). The pinnules are very variable in size

according to the position on the leaf. One of the smaller specimens shown in fig. 38, pl. XV, may possibly represent another species, but is not conclusive. In the undoubted examples the rounded, lateral pinnules vary from 5 mm to 15 mm, which is the largest I have observed in the Canadian impressions. The single terminal pinnules vary from 10-30 mm in length. Fragments of the leaf abound in the series of Fern Ledge beds.

To establish the presence of *N. heterophylla* in the St. John beds is an important point, for the plant is a particularly well-known and representative Coal Measure form and is specially characteristic of the Westphalian series. It has also proved of exceptional interest to the students of plant evolution, for it was the first "fern" impression to which seeds were found attached. Scott's Studies (1909) gives a general account of this very valuable plant, where reference to the detailed work upon it can be found. Reference should also be made to Kidston's (1911, p. 71) latest paper on the subject.

Neuropteris eriana, *Dawson*, sp.

Plate XV, figure 39, and text fig. 11.

1881. *Cardiopteris eriana*, Dawson, Quart. Journ. Geol. Soc., vol. 37, p. 305, pl. XIII, fig. 18.

1882. *Cardiopteris eriana*, Dawson, Foss. Pl. Erian (Devon.) Upp. Silur. Canada, pt. 2, p. 114, text fig. 4.

1910. ? *Cardiopteris eriana*, Dawson, Matthew, Oldest Silur. Flora, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.

The description and figures in the two accounts of the species are identical. The original fragment from which Sir William Dawson's figure is drawn, is No. 3337 in the McGill University collection. The specimen does not offer sufficient colour, contrast or surface sculpturing to make a photograph worth reproduction, so that Dawson's original text drawing is reproduced to represent the type specimen. In my pl. XV, fig. 39, a photograph of a single pinnule is illustrated from the British Museum collection, No. V 4141, which shows the veins very clearly.

As will be noticed, both in Sir W. Dawson's sketch, which is reproduced in the present text fig. 11, and in the photo-

Fig. 11. Neuropteris eriana, reproduced from sketch by Sir William Dawson (1882, p. 114, fig. 4).

graph pl. XV, fig. 39, the form of the base of the pinnule is not that of a true *Cardiopteris*, while the form of the pinnules and their veins both coincide with those of the lateral pinnules of a *Neuropteris*. Personally, I consider that there is little doubt that the plant is really *Neuropteris heterophylla*, (*N. polymorpha* of Dawson). This likeness is noted by Dr. Matthew (1911, p. 13). Nevertheless, as the terminal pinnule is the most distinctive, and as Dawson's *eriana* lacks it, there is the *possibility* that they might have formed different species, so that I am retaining Dawson's original specific name provisionally.

Neuropteris gigantea, *Sternberg*.

Plate XVI, figure 41.

1823. *Osmunda gigantea*, Sternberg, Versuch, fasc. 2, p. 36, pl. XXII, fig. 2.
1826. *Neuropteris gigantea*, Sternberg, Versuch, fasc. 4, p. xvi.
1868. *Neuropteris crassa*, Dawson, Acadian Geol., p. 551.
1871. *Neuropteris crassa*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 50, pl. XVII, fig. 200.
1871. *Neuropteris retorquata*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 50, pl. XVII, fig. 197.
1886. *Neuropteris gigantea*, Sternberg, Zeiller, Fl. Foss. Valenciennes Atlas, pl. XLII, fig. 1.
1888. *Neuropteris gigantea*, Sternberg, Zeiller, Text of same, p. 258.
1910. *Neuropteris crassa* and *Neuropteris retorquata*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.
1910. *Neuropteris gigantea*, Sternberg, Renier, Docum. l'Étude Paléont. terr. houill., pl. C.

Of *Neuropteris crassa* all that Sir William Dawson had was one single pinnule. On this he founded the species and described it in the "Acadian Geology" as follows:—"Single pinnules, broad, oval, oblique at base, thick, smooth above with

very numerous arched veins." This was supplemented by a drawing in 1871, pl. XVII, fig. 200, which indicates that the pinnule was probably the same as those he described in 1871 as *N. retorquata*.

The species *N. retorquata* is based on a number of separate pinnules found scattered on the shales. The type specimen is No. 3322 in the McGill University, and from this it appears that the four pinnules drawn by Dawson, 1871, pl. XVII, fig. 197, were taken; though they do not lie on the block as he has them, it is obvious that they were re-arranged from considerations of space. In my plate XVI, fig. 41, a photograph of the original slab is given.

Dawson remarks that "It is a very distinct species, allied, however, to *N. flexuosa* and *N. gigantea* of the Carboniferous. The pinnules were either somewhat thick or strongly reflexed at the margin. In these characters, as well as in the form of the pinnules, it differs markedly from *N. polymorpha*, with which it is associated in beds at Lepreau."

The justice of the concluding remark will be recognised immediately on reference to the illustrations of "*N. polymorpha*" (see pl. XIV, fig. 35, pl. XV, fig. 38). Dawson recognised that his species was allied to *N. gigantea*, but with his separation of the Canadian specimens from that species, I cannot agree, for they show no single character which justifies the step.

Zeiller (1888, p. 258) gives a very complete and detailed description of the species from large and relatively complete specimens, and he notes that it is very variable. When I was in Paris, M. Zeiller kindly showed me specimens with which to compare Dawson's St. John's type, and among them it was interesting to notice the frequency of scattered pinnules without any rachis. The tendency for the pinnules to drop from the rachis may possibly be a specific character, in which case it would give further support to the view that the St. John specimens are identical with the European ones, because the only examples of the former which exist are merely isolated pinnules.

On the type specimen at McGill are a number of separate pinnules, as can be seen in the photograph. They vary from less than 1 cm to nearly 2 cm in length, and from 4 mm to 8 mm in breadth. There is no distinct midrib, the veins radiating from

the base of the finnule, but in the lower half of the pinnule they run so as to give the appearance of a midrib.

The species *N. gigantea* is widely distributed in the European Coal Measures.

David White (1900, p. 895), in his account of the American Pottsville, mentions that the original form of the species "as described and figured by Sternberg, if present in our Carboniferous basins, appears, so far as yet known, to occur only in the topmost beds of the Pottsville formation." White gives no figures of his Pottsville forms, so that it is not possible to compare them further with those from St. John, but his remarks tend to confirm the determination, were anything further needed after M. Zeiller's remark on seeing the type specimen, that it is "certainly *gigantea*."

Neuropteris Selwyni, *Dawson*

(? *Neuropteris Schlehani* Stur).

Plate XV, figure 37, and text fig. 12.

1871. *Neuropteris Selwyni*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 50, pl. XVII, fig. 198.
[? 1877. *Neuropteris Schlehani*, Stur, Culm Flora Ostauer Schichten, p. 183 (289), pl. XI (XXVIII), figs. 7, 8a, b, c.]
[? 1886. *Neuropteris Schlehani*, Stur, Zeiller, Fl. Foss. Valenciennes, Atlas, pl. XLVI, fig. 3; pl. XLVII, figs. 1, 2.]
[? 1888. *Neuropteris Schlehani*, Stur, Zeiller, text of same, p. 280.]
[? 1907. *Neuropteris Schlehani*, Stur, Potonié, Abbild. Beschreib. Lief v, No. 100.]
1910. *Neuropteris Selwyni*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.

The original specimen on which Dawson's species was founded is No. C in the McGill University collection. A photograph of this is shown in my plate XVI, fig. 37. It is the only specimen of this species from these beds which I have seen, and Dawson mentions that he had only one. Five nearly complete pinnules are attached to the rachis, so that the fragment is small. The drawing in Dawson's plate XVII, fig. 198, however, scarcely does justice to it, and does not bring out the shape of the pinnules particularly well. My photograph also fails to bring out the details of the pinnules as clearly as one would like, owing to the nature of the specimen. Their shape is shown more definitely in the outline drawing in text fig. 12.

Comparison of the actual specimen with the published figures and with the collections in Paris leave no room for doubt that the plant is exceedingly like the *Neuropteris Schlehani* of Stur. Indeed, it is very possible that they are identical, for

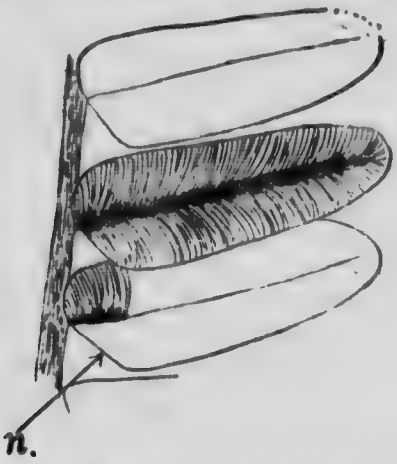

Fig. 12. Neuropteris Selwyni, Dawson. Enlargement of the three central pinnules of Dawson's type specimen, to show their shape, veins and the "notch" n on the lower side of the pinnules. Original of Dawson's fig. 198; cf. fig. 37, pl. XV.

the only point of difference between the St. John and the European species is the small "notch" cut off from the base of the pinnule, of which Dawson speaks.

This may be simply an illusion due to slight displacement of the pinnules before petrifaction, but as of the five pinnules, three clearly show this "notch" we must be content to accept it as a specific character for the present, and hence to separate the Canadian form from the European *N. Schlehani*, although personally I think a determination on such material is far from satisfactory.

The original description of the St. John specimen was as follows:—"Pinnate. Pinnules oblong, narrow at the point, curved upward. The lower side of the base cut off obliquely, so as to form a notch between the pinnule and the petiole. Midrib distinct. Nerves much curved, forking once or twice." (Dawson, 1871, p. 50).

The main character of the pinnules are: their simple, elongated form, in which the two margins are approximately parallel till they come suddenly to the rounded tip of the lamina; the well marked, apparent midrib, remaining distinct almost to the tip of the leaflet; the curve of the veins running to the margin of the leaf; and, in particular for the St. John specimen the small cut or "notch" on the lower side of the base of the pinnules. This is seen in the outline, text fig. 12, at *n*.

In the St. John specimen the pinnules are 12 mm long by 4 mm broad at the base, which is a fair average size for *N. Schlehani*. It must be remarked that the European specimens are large enough to show how the size of the pinnules vary on the same leaf according to their position in it, a fact which is not illustrated by such a small fragment as the St. John specimens.

In his recent "Abbildungen und Beschreibungen" Potonié (1907, Lief. 5.) gives the nomenclature and descriptions, with several figures, of *N. Schlehani*, to which reference should be made. Good figures and a detailed description are also given by Zeiller (1888).

David White (1901 p. 105) writing of the discovery of *Whittleseya Dawsoniana* says the species is associated with "a fragment of *Neuropteris* (labelled *Neuropteris Selwyni*) apparently indistinguishable from a plant from the Upper Pottsville of the Appalachian province described in manuscript by the writer as a variety of *Neuropteris Schlehani* Stur." Which tends to support the view that Dawson's *Selwyni* type is the same as the European form.

N. Schlehani is widely distributed in the European Coal Measures, and is figured recently by Renier among his hundred plates of the characteristic Westphalian plants.

Neuropteris sp.

[=*Nephropteris varia*. Dawson pars.).

Plate XV, figure 40.

1862. *Cyclopteris varia*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 319, pl. XV, fig. 34.

1868. *Cyclopteris varia*, Dawson, Acadian Geology, ed. 2, p. 549.

1871. *Cyclopteris* (*Nephropteris*) *varia*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 47, pl. XVII, fig. 201.
1910. *Nephropteris varia*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.

The original and only specimen of this plant is in the McGill University collection, No. 3310, and a photograph is given of this in Pl. XV, fig. 40 of the present paper.

The leaf is obviously neuropteroid, but is not complete enough to be identified with certainty. Its chief characteristic is the irregularly running prolongations from the pinnules down the rachis, which have veins coming direct to them and not radiating from the main supply of the pinnule. This leaf bears some resemblance to the European *Neuropteris obliqua*, but I was not convinced of their identity. It appears still more like *Neurodontopteris impar* (Weiss) Potonié described and figured by Potonié (1893 p. 1, pl. I, fig. 1) but no satisfactory determination can be made from such a fragment as the St. John specimen, and its specific naming must await the discovery of further specimens.

Genus TRIGONOCARPUM, *Brongniart.*[1]

1828. *Trigonocarpum*, Brongniart, Prodrome, p. 137.
1881. *Trigonocarpus*, Brongniart, Recher. Graines foss., p. 24.

TRIGONOCARPUM PERANTIQUUM, *Dawson.*

1871. *Trigonocarpum perantiquum*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 62, pl. XIX, fig. 228.
1910. *Trigonocarpum perantiquum*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 249.

The specimen is quite indeterminable specifically, but it may possibly be included in the genus *Trigonocarpum*.

Dawson describes the form "Ovate; when full grown, half

[1]Scott and Maslen (1907) use *Trigonocarpus* in their monograph, and on p. 90 they have a foot note explaining their adoption of this form and pointing out the varieties of spelling in different authors. "Brongniart himself in his original Prodrome uses *Trigonocarpum*, in his Tableau *Trigonocarpon* is used, while in the memoir on the St. Etienne the genus appeared as *Trigonocarpus*. . . . Prof. F. W. Oliver, F.R.S., . . . uses *Trigonocarpus*, and for the sake of uniformity among present-day observers we have adopted the same form." But in the face of the clear priority of *Trigonocarpum*, it appears to me that we have no choice in the matter.

an inch wide and one inch long, with obscure indications of ribs toward the narrow end," and he adds that "they resemble some of the Carboniferous *Trigonocarpa*." In view of the abundance of *Alethopteris* foliage, it is most probable that *Trigonocarpum* should be among the débris of the flora (see p. 52).

Genus RHACOPTERIS (*Schimper*), *Stur*. Em.

1885. *Rachopteris*, Stur, Carbon-Fl. Schatzlarer Schichten, p. 5.

This genus of foliage impressions is characterised by simply pinnate fronds, with large, wedge-shaped pinnules alternating along a broad, often furrowed, rachis. The pinnules are more or less irregularly divided into strap-shaped segments, and the veins radiate from the broad base. In fertile fronds, the end of the rachis dichotomises and bears much divided branches with sporangia, recalling those of the living *Botrychium* in appearance, but probably without any real likeness to them.

RHACOPTERIS BUSSEANA, *Stur*.

Plate XVII, figure 43, and text figure 13.

1885. *Rhacopteris Busseana*, Stur, Carbon-Fl. Schatzlarer Schichten, p. 7, pl. LXII, fig. 2.

1906. *Pseudobaiera McIntoshi* and *mut. flabellata*, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 5, p. 394 and 396, pl. VIII, figs. 1-6 and 7.

1910. *Pseudobaiera McIntoshi* and *mut. flabellata*, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.

1911. *Pseudobaiera McIntoshi* and *mut. flabellata*, Matthew, Trans. Roy. Soc. Canada, ser. 3, vol. 4, p. 16, 17, pl. on p. 20, figs. 1–6 and 9.

In Matthew's description of this plant he says: "In the fertile pinnules the lobes are replaced by obovate sporangia or seed vessels, alternately pinnate, as in the barren frond, and becoming smaller towards the end of the pinnule." (Matthew, 1911, p. 15). In my own examination of the specimens, however, which were kindly placed at my disposal in St. John, I did not see any that appeared entirely conclusive in their evidence that this was actually the case. Neither does this fructification (were its attachment certain) appear to support Dr. Matthew's conclusion that the plant is allied to *Baiera*.

Fig. 13. Rhacopteris Bunnana, Stur. Traced sketch from the reverse of Matthew's type for his Pseudobaiera McIntoshi, cf. fig. 6f, pl. XVII. It shows the divided, alternating pinnules and the grooved rachis.

The salient characters of this plant are:—the straight, stout, central rachis down which runs a medial well-marked furrow. This is seen in the upper portion of figure 43, pl. XVII, and in the outline figure, text fig. 13. From this the alternating pinnae are attached by a broad simple base, without definite petiole at intervals of 10–15 mm. These are about 3 cm long in the St. John material, which is nearly all rather incomplete. The pinnae are irregularly divided into several strap-like segments which partly divide again, ending in irregular points or teeth. The main veins appear to be straight, coarse, and simple, and the finer veins are not preserved in the specimens that I have seen.

Potonié (1903, lief. 1) includes Stur's species *R. Bussеana* in Schimper's *Rhacopteris asplenites*, but, in the present imperfect state of our knowledge of the genus, the difference between the two forms seems sufficient to justify the retention of the separate species already instituted. *R. Busseana* has more compact, and much less deeply cut leaves than some of the forms included in *R. asplenites* as re-described by Potonié, and it appears to me that nothing is gained by making tri-nominal varieties in place of the original species.

"*Pseudobaiera*" of Matthew is obviously a *Rhacopteris* as reference to the illustrations in Potonié (1903) and Stur (1885) and to Schimper's, Zeiller's, and Zittel's text books will indicate. It is very similar to *Sphenopteris asplenites*, figured by Geinitz, 1885, pl. XXIV, fig. 6, and it may be that this specimen is really identical with the species figured as *Rhacopteris Busseana* by Stur in 1885. But of the identity of Stur's plant, figured on his pl. LXII, fig. 2, and the Canadian specimen, of which a photograph is given on my pl. XVII, fig. 43, there can be no doubt.

The specimen which I have the privilege of figuring was kindly lent me by Mr. McIntosh, curator of the St. John Natural History Society, and is the reverse of the one figured by Matthew (1911, fig. 1) in his second account of his new genus *Pseudobaiera*.

An outline sketch of this is given in text fig. 13, which shows that though the specimen is far from complete, it is fully sufficient to indicate its perfect agreement with the European type.

The genus is widely distributed in the Coal Measures, particularly in the upper portion of the Middle productive measures.

"FERN" APHLEBIAE

CYCLOPTERIS VARIA, *Dawson*.

Plate XVII, figure 44.

1871. *Cyclopteris varia*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 47, pl. XVII, fig. 202.

Although the name *Cyclopteris varia* was given by Dawson to another plant, which he described as being like some European species of *Neuropteris*, he included in 1871, the present specimen with that *Neuropteris*-like form. Reference to his plate XVII, figures 201 and 202, will show the two specimens which compose his species *C. varia*, and it will at once be seen that one is a *Neuropteris*-like pinnule and the other an Aphlebia. They are on different blocks, in which the matrix differs considerably as to texture, and these two single specimens are the only ones recorded of either form. Consequently, there is no basis for their association together to form a species, and as the neuropteroid fragment (see p. 67, present work) seems to be identical with a European form, it leaves only the one specimen which is a true *Cyclopteris* in the sense defined by Seward (1910, p. 571). He says: "it is now universally admitted that *Cyclopteris* is not a distinct genus and that the specimens so named were borne as modified pinnules on the main rachis of *Neuropteris* and *Odontopteris*. It is, however, convenient to retain the name for detached leaflets which cannot be referred to the fronds on which they were borne."

Dawson's original specimen is illustrated in my plate XVII, fig. 44. It is on the same slab with fragments of "*Neuropteris polymorpha*" (see p. 58) and it is not at all unlikely that it is one of the aphlebiae of this form, for it resembles those known to be attached to the European *Neuropteris*.

CYCLOPTERIS BROWNII, *Dawson*.

1863. *Cyclopteris Brownii*, Dawson, Quart. Journ. Geol. Soc., vol. 19, p. 463, pl. XVII, fig. 6.

1871. *Cyclopteris Brownii*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, p. 46, pl. XV, fig. 172.

1871. *Cyclopteris* (*Nephropteris*) *problematica*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 47, pl. XV, figs. 173, 174
1882. *Cyclopteris* (*Platyphyllum*) *Brownii*, Dawson, Foss. Pl. Erian (Devon.) Upp. Silur. Canada, pt. 2, p. 101, pl. XXIII, figs. 11–13.
1894. *Cyclopteris* sp. cf. *Brownii*, Dawson, Nathorst, K. svensk. vet. Akad. Handl., vol. 26, p. 13, pl. I, fig. 12.
1910. *Nephropteris problematica*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.
1912. *Psygmophyllum Brownii* (Dawson), Arber, Linn. Trans., vol. 7, p. 398.

The fragments described as *C. Brownii* and *C. problematica* by Dawson are exceedingly incomplete and at the same time far too similar to warrant the retention of two distinct specific names, and, therefore, as *C. Brownii* has precedence, I include both sets of impressions under this name. They do not seem to be the same as the Devonian plants Smith and White include in *Platyphyllum Brownianum*.

Dawson's original species was described from the true Devonian rocks, so it is far from certain that the St. John plants really should be included in the same species though in the McGill collection a specimen labelled *C.Brownii* was presented by Sir W. Dawson. The fragments are too imperfect and too unimportant, however, to make it possible or worth while to argue their terminology at length. Dawson compared his impression with that of Rogers (1858) pl. XXII without a name, but as Nathorst (1894, p. 13) pointed out, they do not seem to be the same thing. Arber's association with *Psygmophyllum* seems to be quite unfounded.

FERN APHLEBIAE

[=RHIZOMORPHIA LICHENOIDES, *Matthew*]

1908. *Rhizomorphia lichenoides*, Matthew, Trans. Roy. Soc. Canada, ser. 3, vol. 1, p. 186, pl. 1, fig. 1.
1910. *Rhizomorphia lichenoides*, Matthew, Oldest Silur. Flora, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 247.

As I have not been able to examine the original specimen, I am not in a position to add anything to Dr. Matthew's description. It is most unlikely that it is either a Thallophyte or a Lichen, and the solution of the problem that seems most reasonable is to look on it as a Fern aphlebia.

PTERIDOSPERM FRUCTIFICATIONS?

Genus SPORANGITES, *Dawson*.

1871. *Sporangites*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv., Rep. p. 63.

[Dawson used the generic name as early as 1862, but for other things now known to be spores, etc.]

SPORANGITES ACUMINATA, *Dawson*.

Plate XVIII, figure 46; Plate XXV, fig. 67; and text fig. 14.

1862. *Annularia acuminata*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 312, pl. XIII, fig. 21.
1865. *Annularia acuminata*, Dawson, Hartt in Bailey's Report, p. 135.
1868. *Annularia acuminata*, Dawson, Acadian Geol., ed. 2, p. 540, fig. 194G.
1871. *Sporangites acuminata*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 63, pl. XIX, figs. 232, 234.
1888. *Annularia acuminata*, Dawson, Geol. Hist. Plants, p. 82, fig. 31G. (from 1905 edition).
1910. *Johannophyton discrepans* (fructification only), Matthew, Trans. Roy. Soc. Canada, ser. 3, vol. 3, p, 83, pl. III, figs. 8, 10

Dawson originally described these minute impressions as being related to *A.sphenophylloides*, but after he had had more specimens under observation he concluded in 1871 (p. 63) that they were spore cases. The species was then described as "spore-cases: oblong acuminate, six to nine in a whorl erect, or slightly spreading. Dehiscence lateral."

These little bodies are exceedingly frequent in the shales of the Fern Ledges and often occur in numbers together mingled with a variety of other small fragments. A photograph of a typical surface showing several examples of *Sporangites* with fragments of *Alethopteris* and *Hymenophyllites* is given in the present paper, pl. XVIII, fig. 46. This is taken from specimen 40,530A in the British Museum, which was presented by Sir William Dawson. In text fig. 14 a couple of the small organs are shown natural size, with an enlargement.

Fig 14. Sporangites acuminata, Dawson. Natural size and enlarged. Showing the five-pointed cupule-segments or sporophylls.

As Dr. Matthew (1910 A p. 86) points out, *five*, and not a higher number, is the typical number of parts. Each of the segments is about 5 mm long, with a very sudden and sharp point. Dawson speaks of the longitudinal dehiscence of these spore cases, but I can find no example illustrating this. I have

seen no indication of spores, and the material is too imperfectly preserved in its graphitised form, to obtain any by treatment of a fragment removed from the matrix in the way that has been so successful in Prof. Nathorst's hands with true plant films. The presence of seeds within these small cupules or capsules, or whatever one may call them, has been suggested by Matthew, (ref. ante p. 52) but their existence does not appear to be fully established. The structures certainly suggest the cupule of a Pteridospermic seed, but if that is their nature, it is more probable that they enclosed a single seed and not three, as Matthew suggested.

In fig. 67, pl. XXV, I give an enlarged drawing of a specimen on the British Museum slab (40,530) which is certainly suggestive of a small oval seed within the cupule like segments. But the graphitisation is so extreme that it is quite impossible to be sure that this appearance is not chimerical. The nature of these interesting little bodies must remain problematical till further evidence accumulates.

PTERIDOSPERM FRUCTIFICATION.

PTERISPERMOSTROBUS BIFURCATUS gen. et. spec. nov.

Plate XVII, figure 45; plate XXV, fig. 69; and text fig. 15.

In the British Museum collections, among those specimens obtained from Mr. W. J. Wilson is an exceedingly interesting example of a fructification (V. 4095). This is shown in fig. 45, pl. XVII, of the present paper, and an outline sketch of the specimen is given in text fig. 15. It is most unfortunate that the axis of the specimen is broken away so that it is not possible to see the method of branching on either side, but from the portions that are preserved, it looks as though there had been a simple axis bearing at intervals of 1 cm small lateral branches which ran out almost at right angles for 4 mm, and then bifurcated to two equal stalks about 4 mm long, each of which bore without any scales or bracts, a fertile organ. It is difficult to say whether this organ was a seed enclosed in a cupule, or was a complex male organ. The body has considerable superficial resemblance to a seed enclosed in a cupule, much as we have in *Lagenostoma*.

As Nathorst (1908 p. 10) has pointed out, organs superficially resembling seeds, and which have been identified as such, have proved under more critical examination to have been spore-containing bodies, so that without microscopic data, dogmatic determinations are not to be recommended.

Fig. 15. Pteridospermostrobus bifurcatus, sp. nov. Outline tracing from original specimen, cf. fig. 45, pl. XVII, showing the axis with bifurcating fertile stalks. a, detached fruit body showing three lobes of sporophylls or cupule.

The specimen is, unfortunately, merely a graphitized film like all the St. John material, so that it is useless to anticipate confirmatory results from a microscopic examination of this specimen.

It is difficult even to say precisely how many lobes the "cupule" like structure had. Three are perfectly distinct (see *a*, text fig. 15) and in the other examples there are signs of more, making five a possible number of teeth or lobes. These extend about 3 mm beyond the united basal portion which contained the seed (if it was one) or the series of sporangia or synangia. This region of the organ is 4 mm long by 3 in width. The teeth or lobes of the upper, divided part are continued down the outside of this region as ridges, and there appear to be 3 loculi or ridges visible on one surface of the body of the organ.

A comparison with *Lagenostoma* is obvious; but another possible interpretation of this structure is to look on it as a male

organ composed of five partially coherent sporophylls with free ends, on each of which on the inner side and thus forming a compact pod-like organ, was a row of sporangia or synangia. A restoration of a part of the structure in fig. 69, pl. XXV, brings out the salient features of the branching, etc. The fructification is not paralleled by any known structure of which I am aware. The nearest to approach it is *Lagenostoma Sinclairi* Arber from the Lower Coal Measures of Britain (see Arber, 1905 A) but the mode of branching in the latter species seems much more irregular and spreading.

The Canadian form, for which I must found a new provisional genus and species, may be diagnosed as follows:—

PTERISPERMOSTROBUS *GEN. NOV.*

Founded to include the fructifications of Pteridosperms that cannot be associated with a known species of parent, and that may be either seeds, male organs borne on a definitely branching rachis.

PTERISPERMOSTROBUS BIFURCATUS sp. nov.

Slender rachis 1-1·5 mm wide bearing at intervals of 1 cm lateral axes of equal width which stand at a high angle, and speedily bifurcate to two equal parts, each bearing, without scales or bracts, a fruit body 4mm long, 3mm wide, with projecting (3-5) teeth or cupule lobes about 2 mm in length The main body of the fructification appearing ridged or ribbed, and may contain sporangia (or synangia) or a ribbed seed.

Locality—Fern Ledges, Lancaster, New Brunswick.

Type—V. 4095 in the British Museum Geological Department.

Horizon—Upper Carboniferous, Westphalian.

From the St. John beds, Dr. Matthew (1910A p. 91) has described single bifurcating stalks bearing "elongated lenticular objects that appear to be fruit-vessels" (see his pl. V, figs. 2c and 5). It appears possible that these may be broken fragments of the present fructification though his drawings do not show enough detail to make this certain. He associates his fruit

bodies with *Psilophyton elgans* (see p. 30), but even if his specimens should prove to be portions of *Pterispermostrobus bifurcatus* there is no evidence in favour of associating the structures with *Psilophyton*.

There can be little doubt that *Pterispermostrobus bifurcatus* is the fructification of one of the many species of Pteridosperms so characteristic of the Coal Measure period, and of which fragments of the foliage of several well-known examples abound in the St. John deposits, and though it is unlike the known fructifications of species *Lyginodendron* or *Medullosa* there are many Pteridosperms of which the fructifications have not yet been recognised, to one of which it may very well belong. The most interesting feature of the new plant from St. John is the branching of the axis. Very little is known at present about the exact way the organs of fructification were borne by the Pteridosperms, though in the best known cases, *Lyginodendron* (*Crossotheca*) and *Neuropteris heterophylla* it is certain that the male and female organs were borne on the foliage leaves. Such an axis as *Pterispermostrobus bifurcatus* suggests a specialised segment at least, if not a distinct branch, and raises a number of points which might lead to interesting morphological discussions if more material were available so that the features of the fructification could be established with security.

At present I can only give a preliminary account of the species and await the discovery of further specimens.

GINKGOALES?

Genus WHITTLESEYA, *Newberry*.

1853. *Whittleseya*, Newberry, Cleveland Ann. Sci., vol. 1, 1853, p. 116.

This genus is characteristic of the American Coal Measures, though it has been found in the Schatzlarer Schichten in Europe. For an account of the genus reference should be made to Mr. David White's paper (1901) and to Potonié (1904, lief. II, No. 40). The genus comprises a number of species of simple flabellate leaves with petioles. The lateral borders of the leaves are generally parallel, but the leaves may be wide or linear, and generally narrow down suddenly at the base. White (1899, p. 272) considers that they should perhaps be included in the

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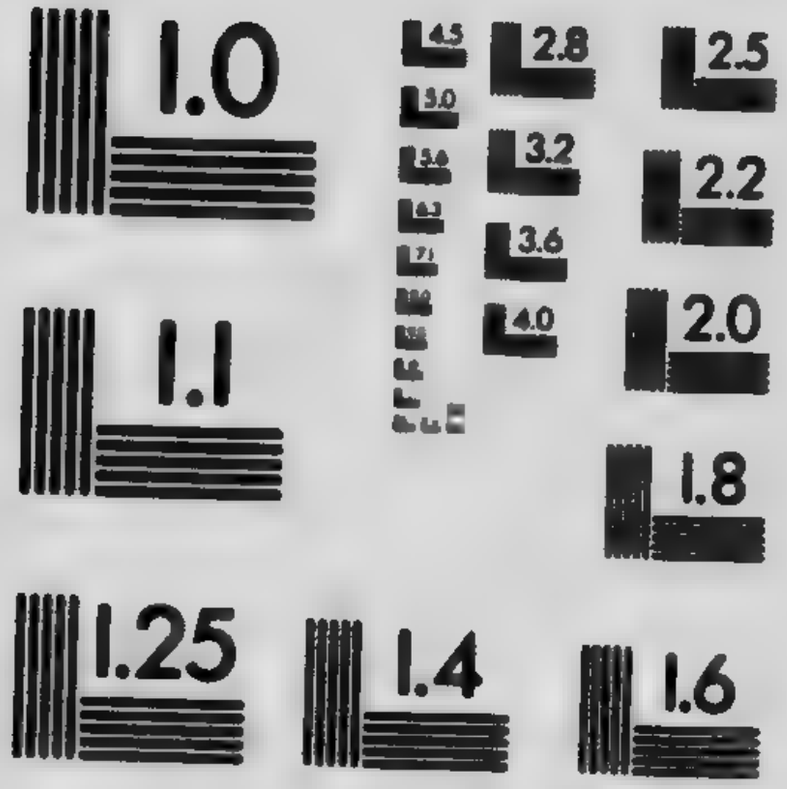
(ANSI and ISO TEST CHART No. 2)



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Ginkgoales. The plants have a characteristic and easily recognisable appearance, so that there need be no doubt about their determination.

This genus was discovered in the upper Palaeozoic rocks of Nova Scotia by Dr. H. M. Ami (1900) in rocks supposed by Sir William Dawson to be Devonian, and probably the equivalents of the St. John beds. Since then species have been discovered actually in the St. John deposit by Mr. David White and Dr. Matthew. This plant's occurrence being so characteristic of Carboniferous rocks in North America it forms one of the strongest links in the chain of evidence for establishing the Carboniferous age of the St. John deposits.

Whittleseya Dawsoniana, *D. White.*

1901. *Whittleseya Dawsoniana*, D. White, Ottawa Naturalist, vol. 15, p. 105, pl. VII, figs. 4, 4a.

1910. *Whittleseya Dawsoniana*, D. White, Matthew, Trans. Roy. Soc. Canada, ser. 3, vol. 3, p. 98, pl. VI, figs. 12, 13.

Mr. David White's diagnosis is as follows:—Leaf very small, short, squarrose, broader than long, truncate at the apex, round-truncate at the base, thick; nerve bands very broad, 1·5 mm-1·75 mm in width, about 10 or 12 in number, parallel to the lateral borders, apparently undivided, and forming very broad and very low flat costae which are contiguous or slightly confluent in the interior of the leaf, each band terminating in a short, broad tooth." The specimen was discovered by Mr. White in the McGill collection on a specimen labelled as *Neuropteris Selwyni* among the St. John plants of Sir W. Dawson.

Whittleseya concinna, *Matthew.*

1910. *Whittleseya concinna*, Matthew, Trans. Roy. Soc. Canada, ser. 3, vol. 3, p. 99, pl. VI, fig. 9.
W. concinna var lata, Matthew, loc. cit., p. 99, pl. VI, fig. 10.
W. concinna var arcta, Matthew, loc. cit., p. 100, pl. VI, fig. 11.

This species collected by Mr. Wilson from the Fern Ledges, St. John, and described by Dr. Matthew, differs from the preceding in the shape of the leaf blade and the character of the veins. It is compared by the author to *W. desiderata* D. White, found in the Harrington river beds.

GINKGOALES ?

Genus DICRANOPHYLLUM, *Grand 'Eury.*

1877. *Dicranophyllum*, Grand 'Eury, Fl. carbonif. Loire, p. 272, pls. XIV and XXV.

The genus was founded by Grand 'Eury for woody branches, bearing distinct leaf bases, to which were attached narrow, dichotomising leaves. The veins of the leaves were simple, parallel, and dichotomising with the divisions of the narrow lamina. The leaves were very numerous, and inserted spirally on the stem, attached to a rhomboidal leaf base cushion. Specimens have been found with small "seeds" attached to leaves nearly resembling the normal foliage, but their structure is uncertain.

The species described are very few, among them *D. gallicum* Grand 'Eury; *D. striatum* Grand 'Eury; *D. tripartitum* Grand 'Eury; and *D. robustum* Zeiller appear practically to have been confined to the *Stephanian* stage of the Coal Measures, so far as present discoveries go. *D. Richiri* is of Westphalian age.

DICRANOPHYLLUM GLABRUM, *Dawson* sp.

Plate XVIII, figure 47.

1862. *Psilophyton ? glabrum*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 315.
1865. *Psilophyton ? glabrum*, Dawson, Hartt in Bailey's Report, p. 135.
1868. *Psilophyton ? glabrum*, Dawson, Acadian Geol., ed. 2, p. 543.
1871. *Psilophyton ? glabrum*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 41, pl. VII, fig. 79.
1910. *Psilophyton (?) glabrum*, Dawson, Matthew, Trans. Roy. Soc. Canada, ser. 3, vol. 3, p. 92, pl. VI, figs. 1–3.
1910. *Psilophyton ? glabrum*, Dawson, Matthew, Oldest Silur. Flora, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.

In his original description Dawson (1862, p. 315) expressed his doubt that this plant belonged to the genus *Psilophyton*, which he had founded. He diagnosed the species as follows:— "Smooth, flattened, bifurcating stems, two lines in width, with a slender woody axis," and he added that the objects were of a doubtful nature, and may have been either roots or stems. In 1871 he states that his doubts were not dispelled about the plant, and to the details of their description adds that their surface was occasionally marked with fine longitudinal striae—

a point which is well brought out in fig. 47 of my plate XVIII. Dawson states that he had some specimens as much as a foot in length, but as I have not seen these, I cannot be sure if these large specimens are identical with the specimen which I take as the basis for determining that the plant is a *Dicranophyllum*.

Dr. Matthew (1910A, p. 92) re-describes this species, and figures a specimen (his pl. VI, fig. 1) collected by Mr. A. G. Leavitt which "exhibits a plant with a dichotomy more exact than is found in any species of Psilophyton." In this feature the plant differs from the Psilophyta of the Gaspe Devonian, as Dr. Matthew points out. He continues: "It is difficult to suggest possible affinities for this plant, and it is only left under Psilophyton because its relationships are still obscure."

The beautiful specimen which was kindly lent to me by the Natural History Society of New Brunswick, and of which I am privileged to publish a photograph (pl. XVIII, fig. 47) demonstrates the nature of the plant so clearly as to remove the doubt as to its nature.

The specimen is 9 cm in length, but is not quite complete. It consists of a dichotomising leaf whose single blade at the base is 3 mm in width. This dichotomises to two blades each 2 mm in width, and each with two prominent double ribs. One of these blades runs for about 2 cm and the other for about 3 cm before each dichotomises again to blades 1·5–2 mm wide. After 3·5 cm these divide again to blades 1 mm wide. Owing to the apparently single ribs (veins) in these terminal portions, I should think it possible that these were the final divisions of the leaf, because in the segment below there are double ribs, and in the one preceding, the four ribs are quite distinct. This can be seen clearly in the photograph. The terminal segments are broken off, and do not conclude in a point, or spine, as would probably be the case were they complete. Enough of the leaf is present, however, to establish its identity with the genus *Dicranophyllum* of Grand 'Eury (see Grand 'Eury, 1877, pl. XIV, fig. 10, and Zeiller, 1880, p. 158, pl. CLXXVI, figs. 1, 2). Renault (1885) discusses the genus in his text books, and reference may be made to his reproductions of Zeiller's and Grand 'Eury's figures (see Renault's pl. IV, figs. 7, 8, 9). One or two other species have been described later by M. Grand

'Eury (1890, p. 335) and by M. Zeiller, but they are less similar to the Canadian species than is *D. gallicum* Grand 'Eury. The Canadian species appears to be distinct from all the European ones, however, notably in its size, which is greater than that described for the French examples.

The Westphalian species *D. Richiri* (Renier, 1910) is not like the Canadian form and has much smaller leaves.[1]

GYMNOSPERMS.

CORDAITALES.

Genus CORDAITES, *Unger.*

1850. *Cordaites*, Unger, Genera et Species Plantar. foss., p. 277.

The group of the Cordaiteae is one of the largest and best known of Palaeozoic plants. They were trees, some reaching as much as 90 ft. in height, with long shafts and a branching crown of leaves. The name *Cordaites* is primarily applied to the leaves, but should include all the parts of the plant as they are associated. The leaves are long sword shaped or linear, simple entire, and may be as much as 90 cm long. They are very coriaceous, with parallel veins which dichotomise at intervals. According to the size and width and shape of the leaves, they were called *Cordaites*, *Poacordaites*, *Dorycordaites*, by M. Grand 'Eury.

The wood of the shafts has variously been named *Araucarioxylon*, *Dadoxylon*, etc., and the internal pith casts are known as *Sternbergia*. The inflorencences are *Coradaianthus* and some of the many species of *Cardiocarpon* are the seeds of the same group. Other "generic" names have been given to different parts of the plant. Reference should be made to the accounts

[1]While passing this through the press, I received a letter from M. Renier in which he says that he agrees with me that most of the specimens of this agree with *Dicranophyllum*, but that in St. John he saw one larger specimen which probably suggests unusual features. I wrote at once for the specimen but have not received it by the time this had to be passed for press.

in Scott's "Studies" and other text books. Recently Dr. Kidston (1911, p. 228) has given a good summary of the Cordaiteae.

Cordaites Robbii, *Dawson*.

[=*C. borassifolius*, Sternb. ?]

Plate XIX, figure 50, and text fig. 16.

1861. *Cordaites Robbii*, Dawson, Canad. Nat., vol. 6, p. 168.
1862. *Cordaites Robbii*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 316, pl. XIV, figs. 31, *a*, *b*, *c*.
1868. *Cordaites Robbii*, Dawson, Acadian Geol. ed. 2, p. 544, fig. 190.
1871. *Cordaites Robbii*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 43, pl. XIV, figs. 157–162 (?).
1886, 1888. *Cordaites borassifolius*, Sternb., Zeiller, Bassin houill. Valenciennes, p. 525, pl. XCII, figs. 1-6.
1888. *Cordaites Robbii*, Dawson, Geol. Hist. Pl. p. 81, fig. 30 (from 1905 edition).
1900. *Cordaites Robbii*, Dawson, Kidston in Ami, Trans. Nova Scotia Inst. Sci., vol. 10, p. 168.
1900. *Cordaites Robbii*, Dawson, White, Foss. Fl. Pottsville Form., p. 903.
1910. *Cordaites Robbii*, Dawson, Matthew, Nat. Hist. Soc. New Brunswick, vol. 6, p. 249.

The beautiful little cluster of leaves figured by Dawson in 1862 is shown in fig. 50, pl. XIX of the present paper from the specimen now in McGill University collection (No. 3299). The definition of the species given by Dawson (1862, p. 316) is: "Leaves, elongated, lanceolate, sometimes three inches wide and a foot in length. Veins equal and parallel. Base broad, clasping the stem, point acuminate." To this description nothing was added in the 1871 memoir, but a single larger leaf was figured (now No. 3295 in the McGill collection) which clearly shows a different type of venation, and belongs to *C. principalis* (see fig. 51, pl. XX, and p. 84). Dawson states (p. 317, 1862): "The present species so closely resembles *C. borassifolia* of the Coal-formation that it might readily be mistaken for it, but it differs somewhat in the form of the leaf, and still more in the venation, the nervures in the present species being perfectly *equal*." To this he adds a footnote: "The nervures in *C. borassifolia* are alternately thick and thin; but there is an undescribed species in the Upper Coal measures of Nova Scotia which has equal nervures."

In the cluster of small leaves most of the veins are highly graphitised, and in those portions the thick veins stand out as strong silver lines about 0·5 mm apart, and all equal, as Dawson describes them. There are, however, finer lines between these in the less graphitised parts of the leaf, where as a consequence the more delicate surface features are better preserved. Such an alternation of strong and delicate veins can be seen clearly in the specimen and can be made out quite well with a hand lens at the region *v* in fig. 50, pl. XIX.

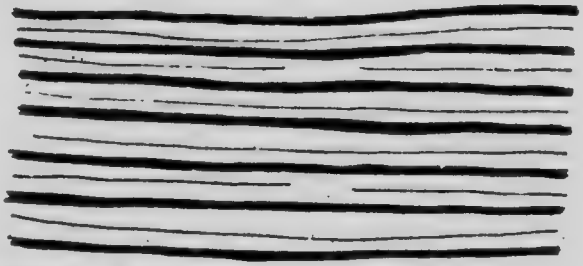

Fig. 16. Cordaites Robbii, Dawson (C. borassifolius?). Portion of leaf enlarged to show fine veins alternating with coarse ones.

In text fig. 16 I illustrate an enlarged portion of the leaf to show the veins. This should be compared with the figures on Zeiller's (1886) pl. XCII, illustrating *C. borassifolius*.

I confess that in view of this, and the frequency of the species in the Nova Scotia Coal Measures, I should be inclined to include *C. Robbii* in the European *C. borassifolius*. But identification of species from leaves alone is always fraught with danger, and in a case like these *Cordaites* where there is so little characteristic detail, it is particularly insecure to do so. Furthermore, the shape of the small leaves of the *Robbii* cluster differs slightly from those common in *borassifolius*, and I, therefore, retain Dawson's name, with the qualifying remark, that the species is probably near to, if not identical with, *C. borassifolius*.

Dawson (Acadian Geol., p. 459) describes *Cordaites borassifolius* from the Nova Scotia Coal Measures. David White (1899, p. 260) describes *C. communis* from the Missouri Coal Measure, and says that the distinction between

this and some of the forms recorded as *C. borassifolius* is not clear to him. In his account of the Pottsville, White (1900, p. 903) identifies *C. Robbii* from the American localities and says:—"The identification of the leaves from the Pottsville formation with the species described by Dawson from the fern ledges at St. John, New Brunswick, seems to be fully assured by a comparison of material from the type locality. The species appears to be especially common in the Upper Lykens division of the formation, although it has a wider vertical range."

Cordaites principalis, *Germar* sp.

Plate XX, figure 51; Plate XXI, figure 53.

1848. *Flabellaria principalis*, Germar, Verstein, Steinkohl, Wettin. Löbejün, p. 55, pl. XXIII.
1855. *Cordaites principalis*, Geinitz, Verstein, Steinkohl Sachsen., p. 41, pl. XXI, figs. 1, 2, 2A, 2B.
1871. *Cordaites Robbii*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 43, pl. XIV, fig. 156.

[For complete synonymy see Kidston 1911, Végét. houill., Belge, p. 232.]

The larger leaf figured in 1871 Dawson (fig. 156, pl. XIV) has a different venation from that in the small cluster (see p. 82), and, as Dr. Jongmanns pointed out to me, it agrees entirely with *C. principalis*. I have seen no leaf that approaches completeness, but fig. 51, pl. XX, and fig. 52, pl. XXI of this paper, give a fair idea of the size and form of the leaf. The series of narrow veins alternating between the broader ones are sometimes 2, 3 or 4 in number, and can be seen at *V* with a hand lens on fig. 51, pl. XX.

This form of leaf is very much commoner than the true *Robbii* type, and, indeed, the majority of the larger leaves I found so commonly in all the beds of the Fern Ledges belong to it.

Poacordaites sp.

Plate XX, figure 52.

1871. *Cordaites* sp., Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 44, pl. XIV, figs. 164, (165 ?).

The specimen illustrated in figure 52, pl. XX of the present paper is No. 3298 in the McGill collection, and appears to be the original of Dawson's 1871 figure 164, pl. XIV. Dawson

said "Unless merely a variety of *C. Robbii*, these may be entitled to a specific name."

The leaf belongs to the *Poacordaites* type, and is long and slender, 0·7-1 cm. in width, with simple equal parallel veins. It is distinct from *C. Robbii*, and is very much rarer. It is not well enough preserved to be identified specifically.

Dadoxylon Ouangondianum, *Dawson*.

1861. *Dadoxylon Ouangondianum*, Dawson, Canadian Nat., vol. 6, p. 165, figs. 1-4.
1862. *Dadoxylon (Araucarites) Ouangondianum*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 306.
1868. *Dadoxylon Ouangondianum*, Dawson, Acadian Geol., ed. 2, p. 534, fig. 185.
1871. *Dadoxylon Ouangondianum*, Dawson, Fossil Pl. Devon. Up. Silur. Form., Geol. Surv. Can., p. 12, pl. I, figs. 1-4 and 15.
1888. *Dadoxylon Ouangondianum*, Dawson, Geol. Hist. Plants, p. 79, fig. 29 and p. 96 (1905 edition).
1910. *Dadoxylon (Araucarites) Ouangondianum*, Dawson, Matthew, Trans. R. Soc. Canada, ser. 3, vol. 3, p. 77, pl. I, pl. II, figs. 1-6.

The larger trunks on which this species is based come from the Little River series of sandstones. The petrified wood has been so fully described, both by Sir William Dawson, and more recently, by Dr. Matthew, that there is no necessity to recapitulate the facts here. The wood elements had several confluent series of hexagonal bordered pits, and the trunk agrees with the petrified woods of the genus *Cordaites* of which abundant [illegible]re found in the shales.

Pith casts of Cordaites.

Sternbergia sp., *Dawson*.

Sternbergia sp., Dawson, Foss. Pl. Devon. Up. Silur. Canada, Geol. Surv. Rep., p. 21, pl. III, fig. 29.

These are pith casts entirely denuded of wood, and which probably belonged to the stems of *Cordaites* described as *Dadoxylon Ouangondianum*.

Cordaianthus devonicus, *Dawson* sp.

Plate XXI, figures 54, 55; plate XXII, figure 57; plate XXV, fig. 66; text figs. 17, 18.

1868. *Antholithes Devonicus*, Dawson, Acadian Geol., ed. 2, p. 556, fig. 194E.
1871. *Antholithes floridus*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Sur. Rep., p. 63, pl. XIX, fig. 236.

1871. *Antholithes Devonicus*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 63, pl. XIX, fig. 235.
1888. *Antholithes Devonicus*, Dawson, Geol. Hist. Pl., p. 82, fig. 31F (in 1905 edition).
1910. *Antholithes Devonicus* and *A. floridus*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 249.

Dawson himself recognised that the fructifications he had earlier called *Antholithes* belonged probably to *Cordaites*. He speaks of *Cordaites Robbii* from the New Brunswick beds "where it occurs with two species of Antholites—*A. Devonicus* and *A. floridus*—perhaps its male and female flowers, and with the species of Cardiocarpa already mentioned."

The originals of the two species described by Dawson are numbers 3284 and 3276 in the McGill University collection, these are shown in figures 55, plate XXI, and 57, pl. XXII, in the present work. Both are very much graphitised, and consequently magnification by a lens renders no ultimate details visible. The original of Dawson's *Antholithes Devonicus* is a fine portion of an inflorescence, nearly 10 cm long. This is seen in fig. 57, pl. XXII, which shows clearly the long pointed subtending bracts below the fertile lateral

Fig. 17.—Cordaianthus devonicus, Dawson. Outline sketch of the original specimen; cf. fig. 57, plate XXII. *b*, subtending bracts; *f*, fertile axes.

axes. A rough outline sketch of this is given in text fig. 17, *b*. Figure 54, pl. XXI, the original of *A. floridus*,

shows the lateral fertile axes more clearly, but the long pointed subtending bract is not visible. This is merely due to its being broken off however, as is evident in the specimen at *b*. The apparent lack of the long bract in *floridus* is really the only point which served to separate it from *devonicus*, and as it is quite clear that the bract was simply broken off in the specimen, the two species must be put together, when the name *devonicus* has priority. Personally, I can see no real difference between this and the *A. spinosus* described by Dawson from Nova Scotia (see Acadian Geol., p. 460) but as I have not seen the latter specimens I cannot be certain of their specific identity.

The specimens consist of a central axis, apparently flattened, and 3-4 mm thick. Along this alternating at a distance of about 1·5 cm from each other are apparently only the two rows of lateral fertile axes. Each of these is subtended by a pointed large bract, about 1·5 cm long and 1-1·5 mm broad, which is broken off near the base in most cases. The number of scales in the small lateral axes is considerable, but the specimens are not distinct enough to allow their exact number to be counted. Each scale appears 6 or 7 mm long and is pointed. A somewhat diagrammatic restoration of the whole is given in fig. 66, pl. XXV.

These inflorescences are far from common, and I did not obtain any further specimens while collecting. A small part of one is in the British Museum collection, V 4097, and is shown in the sketch, text fig. 18. The plant much resembles the *Cor-*

Fig. 18. Cordaianthus devonicus, Dawson. Small specimen in Brit. Mus. Coll., No. V4097; from St. John.

daianthus figured on his pl. XXVI, by Grand 'Eury (1877) though Grand 'Eury's specimen are on a smaller scale. The

photograph he gives on his pl. V, phot. 8, of *Botryoconus* (Grand 'Eury, 1890) also is very similar to the Canadian impressions.

There is no doubt that the inflorescence belongs to *Cordaites*, and probably is the female fructification in a young state before the seeds had ripened. I cannot recognise the little flower like structures shown by Dawson in his 1871 restoration, (see his pl. XIX, fig. 235c) the phenomena on which he based his drawing appearing to me to be disintegrated portions of a scale showing brightly, due to its graphitisation.

Genus CARDIOCARPON, *Brongniart.*

1828. *Cardiocarpon*, Brongniart, Prodrome, p. 87.

"Fruits comprimés, lenticulaires, cordiformes ou réniformes terminés par une pointe peu aigué." This is the original diagnosis of the genus given by Brongniart for a number of species of Coal Measure seeds. The name has been changed slightly from time to time by various authors, Renault calling those examples which were known to belong to *Cordaites*, *Cordaicarpus*. In the genus, which is certainly an artificial one judged by the modern standard of a genus, are placed flattened, bilaterally symmetrical seeds. They are lenticular in cross section, and oval or cordate in outline with a more or less cordate base. They generally show at least two seed coats, an inner stony sclerotesta, and an outer fleshy sarcotesta, which may or may not have a dilated wing. In some forms the wing is very extensive and thin, and these are then separated by some writers from "Cardiocarpon" and called Samaropsis.

The seeds of the "genus" *Cardiocarpon* certainly belong to a number of different vegetative genera, some of them probably in the Pteridospermae, and some in the Cordaitean plexus.

Generally allotted to *Cordiates* are the oval and orbicular forms with a relatively small wing or sarcotesta.

White (1908) considers that some of the Cardiocarpons belong to *Gangamopteris* and other plants of Gondwana age which were presumably Pteridosperms. The internal structure of some species of *Cardiocarpon* is known, principally from the French material, see Brongniart's classic work on Carboniferous seeds (1881) and Scott (1909).

Cardiocarpon cornutum, *Dawson*.

Plate XXI, figure 56; plate XXII, figs. 58, 59; plate XXIII, figs. 60, 62.

1868. *Cardiocarpum cornutum*, Dawson, Acadian Geol., ed. 2, p. 554, fig. 194A.
1862. *Cardiocarpum cornutum*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 324, pl. XIII, figs. 23, 24.
1871. *Cardiocarpum cornutum*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 60, pl. XIX, figs. 214–218.
1888. *Cardiocarpum cornutum*, Dawson, Geol. Hist. Plants, p. 82, fig. 31A (from 1905 edition).
1900. *Cardiocarpum cornutum*, Dawson, Kidston in Ami, Ottawa Nat., vol. 14, p. 100.
1900. *Cardiocarpon cornutum*, Dawson, David White, Pottsville formation, p. 903, and p. 908, pl. CXCIII, fig. 10.
1910. *Cardiocarpon cornutum*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. [illegible] p. 249.

These seeds are exceedingly frequent in the St. John shales, both singly and in numbers together (see fig. 60, pl. XXIII, of a block I found in Duck cove with half a dozen seeds together on it). Specimens were fully illustrated by Dawson in 1871, and further examples are shown in figs. 56, 58-60 and 62, pl. XXI, XXII and XXIII in the present paper. The outline and also the shape of the apical sinus vary somewhat in the different specimens, partly owing to slight distortion, but probably also owing to the examples being of slightly different stages in their development. The seeds average 12-14 mm in width and 12-15 mm in length, though they are not circular in outline. The stony envelope is more nearly circular and is about 8 mm in diameter, it has a small funnel like apical projection which must presumably have been a sclerised micropylar tube, see figs. 56, pl. XXI, and 62, pl. XXIII. In some specimens, see figs. 58 and 59, pl. XXII, and text fig. 20, it looks as if there had been a median groove in the stone. The specimens are all graphitised too much for the inner details to be made visible by any treatment. In one specimen there are two deep lateral sinuses so placed as to suggest very strongly a resemblance to a dicotyledonous embryo, but though the specimen is too good to be dismissed as impossible, it is not good enough firmly to establish Dawson's interpretation (p. 61, 1871) that the seeds had a large embryo with two cotyledons embedded in an albumen. As this would be the only case of a Palaeozoic seed in which an embryo has been found, notwithstanding the fact that numbers of beautifully petrified structures

have been exhaustively studied by many palaeobotanists, it would require a better basis for its establishment than is afforded by the one graphitised and incomplete specimen from St. John.

The small cup like hollow formed at the apex of the wing is sometimes closed or nearly closed over the top by the claw like tips of the wing, in others it is open like a small bowl. Examples of different apices of the seeds are shown in text fig. 19, and can also be recognised in the photographs of pls. XXI, XXII and XXIII.

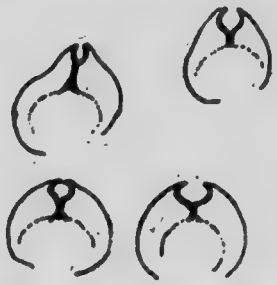

Fig. 19. Cardiocarpon cornutum, Dawson. Apices of seeds, showing the indentation of the wing above the micropyle.

Dawson (1871, p. 61) concluded that the structure of these seeds was similar to that of *Taxus* and the "woody tegmen [was] surrounded by a fleshy outer coat, and that the notch at the apex represents the foramen or micropyte of the ovule." Though at first sight this seems an attractive view, and the resemblance between this seed and the *diagrams* published of gymnospermic seeds with pollen chambers is considerable; it must be remembered that these diagrams are made from longitudinal sections and that in the St. John specimens we are dealing with the entire seeds flattened out, which consequently could not show its pollen chamber in this diagrammatic way, for it would be covered by the outer layers flattened over it. The fact that the cup shaped hollow in the top of the St. John specimens is not veiled or covered by any film of a membrane shows that it was not a three-dimensional pollen chamber, but a simple notch in a flat wing. The seeds doubtless had pollen chambers, and micropyles leading to them, but they were in the apex of the

stone and the small tube-like extension running from it to the base of the sinus in the wing enclosed in the micropyle. (See text fig. 20).

Fig. 20. Cardiocarpon cornutum, Dawson. Sketch of seed showing ridge (?) of stone; of fig. 58, plate XXII. Enlarged.

In recording the existence of *Cordaites Robbii* in the Pottsville, David White (1900, p. 903) says: "In the Southern anthracite field the species occurs, as at St. John, in association with *Cardiocarpon cornutum*."

The inference from this association as well as the great frequency of these seeds, together with the great abundance of *C. Robbii* in the St. John shales, is that the seeds are those of that species of *Cordaites*. This cannot be established conclusively, however, from the material at present available.

Among European forms the nearest ally appears to be *Cardiocarpon* (*Samaropsis*) *emarginatum*, see pl. XXII, fig. 3, in Kidston's (1911) monograph on the Belgian Coal Measures, the likeness of which to the Canadian seeds was pointed out to me by M. Zeiller. The two do not appear to be identical, however, and the Canadian *cornutum* seems a distinct and readily recognisable species.

Cardiocarpon obliquum, *Dawson*.

1862. *Cardiocarpum obliquum*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 324, pl. XIII, fig. 25.
1868. *Cardiocarpum obliquum*, Dawson, Acadian Geol., p. 554, fig. 194B.
1871. *Cardiocarpum obliquum*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 61, pl. XIX, figs. 225, 226.
1888. *Cardiocarpum acutum* (L. & H.), Dawson, Geol. Hist. Pl., p. 82, fig. 31B.
1900. *Cardiocarpon obliquum*, Dawson, David White, Potteville Formation, 20 Ann. Rep. U.S.A. Geol. Surv., p. 909.
1910. *Cardiocarpon obliquum*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 249.

This seed is much smaller than most of the Cardiocarpons, and measures only 8×4 mm. The only specimen of it that I have seen is one in the Natural History Museum, St. John, and which appears to be the original of Dawson's 1871 figure. I have not permission to re-figure this specimen. From the St. John specimen, it is difficult to say whether we are dealing with a very minute seed provided with a stiff wing, a wingless seed, or with the crushed stony portion of a larger seed from which the wing, or outer fleshy layer, had delayed or broken away. Mr. David White (1900, p. 909) considers it a distinct species, and records it as being especially common in the drift in the Upper Lykens (Pottsville) coal. He notes that it is "unquestionably distinct from *C. acutum*, L. & H."

Cardiocarpon ovale, *Dawson.*

1871. *Cardiocarpum ovale*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 60, pl. XIX, figs. 223-224.
1910. *Cardiocarpum ovale*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 249.

I have not studied the original specimen from which Dawson founded his species, nor have I seen any other example of the form. Dawson describes it (p. 60): "Oval and destitute of a notch, the sides of the margin expanded laterally, the nucleus ovate and acuminate."

The illustration and description show that the seed was not one that has any salient feature by which it can be readily determined.

Cardiocarpon Baileyi, *Dawson.*

Plate XIX, figure 48; text fig. 21.

1868. *Cardiocarpum Baileyi*, Dawson, Acadian Geology, p. 554, text fig. 194D.
1871. *Cardiocarpum Baileyi*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 60, pl. XIX, fig. 219.
1888. *Cardiocarpum Baileyi*, Dawson, Geol. Hist. Plants, p. 82, fig. 31D (from 1905 edition).
1910. *Cardiocarpon Baileyi*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 249.

I have only seen a single example of this seed, the type specimen figured by Dawson. This is in the McGill University collection, No. 109, and is shown in fig. 48, pl. XIX, in the present paper.

Of it Dawson only said: "Broadly cordate, emarginate at apex, one inch and a half broad, one inch long. Nucleus large, broadly oval, acuminate, with a mesial line reaching to the ends."

Unfortunately the specimen is merely a graphitised film and, therefore, does not reveal the intimate details of the seed, which would be of such interest. An outline tracing from a photo is given in text fig. 21, where it will be seen that it is

Fig. 21. Cardiocarpon Baileyi, Dawson. Outline tracing of original and only specimen cf. fig. 48, plate XIX.

somewhat distorted, but that it shows clearly the distinction between the broad wing (1·5 cm on either side) and the central, presumably stony covering, 1 cm in diameter.

The seed was presumably flat, and bi-laterally symmetrical with a sudden sloping in of the wing on either side of the micropylar region.

C. Newberryi Andrews, 1875, p. 425, pl. XLVI, fig. 2, very much resembles this seed. Andrews says: "It resembles in its wings *C. Bayleyi*, Dawson, from the Devonian of New Brunswick, but the nucleus is wider and more acuminate in the apex."

As, however, there appears to be but a single specimen of each available, and as the matrix of the St. John one is slightly distorted, it is not possible satisfactorily to establish their identity. I think, however, we can safely assume from their very unusual size, and from the fact that other specimens from the two beds also agree, that these are very closely allied, if not identical species. These two resemble each other even more than do either the *C. Girtyi* of David White (1900, p. 907), with which, however, both are probably closely related. White

says: "*Cardiocarpon Girtyi*, together with *Cardiocarpon Phillipsi*, *C. Newberryi*, *C. samaraeforme*, *C. annulatum*, *C. dilatatum*, and *C. ingens*, constitute a group of large, broad-winged species of the genus, whose occurrence is characteristic of the Upper Lykens division or the Sewanee zone of the Pottsville." . . . "*Cardiocarpon Baileyi* . . . appears to be a very closely related species." Large seeds, somewhat similar to *C. Baileyi*, though a little smaller and not so laterally extended, are known also from the European coal measures. For example, those figured in Fiedler, 1857, pl. XXVIII, figs. 36, 37, 43, 44, and 46 as *Jordania*. The latter (fig. 46) is a reproduction of the seed figured in 1841 by Corda as *Carpolithes macropterus*.

Cardiocarpon Crampii, *Hartt.*

Plate IX, figure 21; plate XIX, figure 49; and plate XXV, figure 68.

1868. *Cardiocarpum Crampii*, Hartt, Dawson Acadian Geol., ed. 2, p. 554, p. 194C.
1871. *Cardiocarpum Crampii*, Hartt, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 60, pl. XIX, figs. 220–222.
1888. *Cardiocarpum Crampii*, Hartt, Dawson, Geol. Hist. Pl., p. 82, fig. 31C (from 1905 edition).
1910. *Cardiocarpon Crampii*, Hartt, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 249.

Several examples of these seeds are available, but they are relatively rare in comparison with *C. cornutum*. In one specimen (No. 3277 in the McGill University collection) two seeds are lying beside each other. This is shown in pl. XIX, figure 49, in the present paper, which illustrates the main characters of the type. The narrow elongated seed is small, about 5 mm by 2–3 mm, with very pointed ends, and is surrounded by a relatively broad wing of 2–3 mm extension on either side which brings up the size of the structure as a whole to 2–2·5 cm in length and 6–7 mm in breadth.

In one of the specimens figured by Dawson (figs. 220 and 222, pl. XIX, 1871) there is an opening at one end which probably corresponds to the notch in the wing of *C. cornutum* above the micropyle, and, therefore, may be taken as an indication that it is the micropylar end in *C. Crampii* also. In fig. 62, pl. XXV, is shown a sketch of such a seed from the St. John Natural History Museum. A median ridge runs from end to

end of the seed, which appears to have been much flattened. An almost identical type from Europe is figured by M. Zeiller (1892, pl. XV, figs. 8–10); it is known from the Upper Coal Measures of Commentry, and the passage beds between the Coal Measures and Permian. Reference should also be made to the figures in Potonié (1893A, pl. XXXII, figs. 12, 13) and in Renault (1890, pl. LXXII, fig. 35).

Such seeds, however, which are of infrequent occurrence and have not been satisfactorily studied or allocated to their parent plant, can scarcely be considered to have much weight as an indication of the geological age of the deposits in which they occur. They probably belonged to some member of the widely distributed Cordaitean plexus.

Notes on the plants recorded from St. John and not accounted for in the preceding descriptions.

[These are given in Alphabetical order under the name by which they were described. I wish to make it clear, however, that by listing these determinations I do not intend to perpetuate them, but merely to ensure convenience of reference.

The species which have been founded on the following specimens do not appear really to be established, and the names consequently should be eliminated from palaeobotanical lists.]

ALETHOPTERIS INGENS, *Dawson.*

1862. *Pecopteris* (*Alethopteris*) *ingens*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 322, pl. XV, fig. 41, *a*, *b*.
1868. *Alethopteris ingens*, Dawson, Acadian Geol., ed. 2, p. 553.
1871. *Alethopteris ingens*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 55, pl. XVIII, fig. 206.

I have not seen a specimen that I can identify with certainty as the original of the folded pinnule that formed the basis of fig. 41 in Dawson's description of the species in 1862. In the McGill University collection, however, there is a somewhat similar fragment, with a small label "*Alethop. ingens*" in Dawson's handwriting, which we can, therefore, take as representative of the species, and which is probably the real type specimen.

The specimen is only a *portion* of a separated pinnule and so far as its features are discernible in such a poor fragment, is entirely the same as that figured by Dawson in 1871, pl. XVIII as "*Alethopteris discrepans* broad variety." That is to say, it is merely a portion of *A. lonchitica*. Dawson's remark (1871, p. 55) that the pinnules are "more than an inch wide" is perhaps based on a misinterpretation of this specimen, where two pinnules lie overlapping in such a way that without very close examination they might be taken as one broad leaflet.

In describing his *Taeniopteris? micsouriensis*, White (1899, p. 142) notes that the *Alethopteris ingens* as described by Dawson is a somewhat similar form. He quotes Dawson's (1871) description, but in this the illustration showed only a portion of the venation which with that of a number of other forms, resembles his species. The actual venation of Dawson's fragment, however, is that common to the genus *Alethopteris*, and Dawson's own specimen of *A. ingens* is an entirely undiagnosable fragment of two pinnules, squashed and superimposed, which appear to belong to *A. lonchitica*.

Alethopteris Perleyi, *Hartt.*

[Possibly equivalent of *Pecopteris serrula* Lesquereux].

1868. *Alethopteris Perleyi*, Hartt, Acadian Geol., ed. 2, p. 554, fig. 192M, on p. 548.

1871. *Alethopteris Perleyi*, Hartt, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 55.

1888. *Alethopteris Perleyi*, Hartt, Dawson, Geol. Hist. Plants, p. 73, fig. 23M (in 1905 edition.)

The outline text figure of a minute fragment of a pinnule is all the illustration given with the original description, and the same cut is repeated in 1888, where nothing is added to the account of the plant.

I have not been able to locate the original specimen of Dawson's fragmentary illustration, so that it is not possible to determine exactly what it is. Dawson (1868, p. 554, and 1871, p. 55) compares it to *Alethopteris serrula* of Lesquereux, which, as Schimper long ago pointed out is not an *Alethopteris* at all. David White (1899, p. 73) under the genus *Aloiopteris* discusses the systematic position of *Pecopteris serrula* Lx. and other

species of what evidently constitutes a peculiar group in the genus. There is, however, no certainty that Dawson's minute fragment is identical with this species, and it is much too imperfect a scrap on which to found a species.

Annularia (?) ligita, *Matthew.*

1906. *Annularia (?) ligita*, Matthew, Trans. Roy. Soc. Canada, vol. 12, p. 128, pl. II, fig. 4.
1910. ?*Annularia ligita*, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 247.

Matthew's drawings do not suffice to establish a new species, particularly when the nature of the impressions is taken into consideration. I have not had the privilege of examining the original of this fern, so can judge merely from the published description and figure. Matthews himself (1906, p. 128) says "the material is too defective for diagnosis."

Annularia recurva, *Matthew.*

1906. *Annularia recurva*, Matthew, Trans. Roy. Soc. Canada, vol. 12, p. 128, pl. II, figs. 1-2.
1910. *Annularia recurva*, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 247.

This "species" seems to be founded on very imperfectly preserved and somewhat altered fragments, and is not one which can be regarded as a true species.

Archaeopteris Jacksoni, *Dawson.*

1861. *Cyclopteris Jacksoni*, Dawson, Canadian Nat., vol. 6, p. 173, fig. 9.
1862. *Cyclopteris Jacksoni*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 319.
1868. *Cyclopteris Jacksoni*, Dawson, Acadian Geol., ed. 2, p. 547, fig. 191.
1871. *Cyclopteris (Archaeopteris) Jacksoni*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Rep. Geol. Soc., p. 45, pl. XV, figs. 167-169.

For the complete list of references to this species in the literature, see Smith and White, 1905, p. 39. The fine plant figured by Dawson in 1871 (pl. XV. fig. 167) is from the Gaspe beds, which are undoubtedly of Devonian age. Examples of this species should not be included among the St. John plants from the beds under present consideration. The fragment No. (3) on label entered as *Cyclopteris Jacksoni* in the McGill University collection from the "Little River" beds of St. John is a *Neuropteris*.

Archaeopteris? sp. *Dawson.*

1861. *Archaeopteris* ? sp., Dawson, Quart. Journ.. Geol. Soc., vol. 37, p. 305, pl. XIII, fig. 19.

I have not been able to locate the original specimen of this fragment. Dawson's description is as follows:—"Petiole apparently woody, bearing broadly obovate decurrent pinnules, with strong, flabellate, straightish nerves. Pinnules overlapping each other. This plant bears a general resemblance to *Archaeopteris* of the type of *A.* (*Cyclopteris*) *Maccoyana* of Geppert; but the woody petiole or branchlet, and the coarse texture raise the suspicion that the specimen may not be a Fern, but may have belonged to a coniferous tree of the type of *Voltzia* or *Salisburya*."

From this it will be seen that without further confirmatory evidence, this plant cannot be taken as an indication of the existence of *Archaeopteris* in the St. John beds.

Asterophyllites fasciculatus, *Matthew.*

1906. *Asterophyllites fasciculatus*, Matthew, Trans. Roy. Soc. Canada, vol. 12, p. 121, pl. I, fig. 2.
1910. *Asterophyllites fasciculatus*, Matthew, Oldest Silur. Fl., Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 247.

The name, given as "*n.sp.*" by Matthew in 1906, is preoccupied, for it was used by Lesquereux in 1879 in his Atlas to the Coal Flora of Pennsylvania, p. 2, pl. III, figs. 1-5.

The fragment described by Matthew however does not merit the formation of a species for its reception, for as he himself remarks, it is not separable from *A. longifolia* by its leaves.

The fact that the nodes are inconspicuous is not a sufficient basis for forming a new species even were the specimen a good one, but this is an exceedingly poor and indistinct fragment.

?Asterophyllites fissus, *Matthew.*

1906. *Asterophyllites* (?) *fissus*, Matthew, Trans. Roy. Soc. Canada, vol. 12, p. 121, pl. VI, figs. 4, 5 and 6 (?).
1910. ?*Asterophyllites fissus*, Matthew, Oldest Silur. Flora, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 247.

The foundation of a new species on these fragments cannot be upheld. They are not even determinable with certainty, and all one can say is that possibly they belong to *Asterophyllites equisetiformis.*

Asterophyllites longifolius, *Sternberg*.

1862. *Asterophyllites longifolia*, Brongniart, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 311.
1868. *Asterophyllites longifolia*, Brongniart, Dawson, Acadian Geol., ed. 2, p. 539 (doubtful).
1906. *Asterophyllites longifolius*, Sternb., Matthew, Trans. Roy. Soc. Canada, vol. 12, p. 120, pl. I, fig. 3.

Reference to the only illustration of this species from these beds will show how insecure is the determination. Though *A. longifolius* is a well-known European form which was very probably present in the St. John beds, I cannot make any use of such records as are available, for the material is too imperfect to establish its existence there.

Asterophyllites scutigera, *Dawson*.

1862. *Asterophyllites ? scutigera*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 311, pl. XIII, figs. 18, 19, 20.
1868. *Asterophyllites ? scutigera*, Dawson, Acadian Geol., ed. 2, p. 539, fig. 187C.
1871. *Asterophyllites scutigera*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 29, pl. V, figs. 58, 59.
1888. *Asterophyllites scutigera*, Dawson, Geol. Hist. Plants, p. 78, fig. 28c, c^1, (1905 edition).
1906. *Lepidocalamus scutiger*, (Dawson), Matthew, Trans. Roy. Soc. Canada, ser. 2, vol. 12, p. 117, pl. IV, figs. 1–8; and p. 119, pl. IV, fig. 9.
1910. *Lepidocalamus scutiger*, (Dawson), Matthew, Trans. Roy. Soc. Canada, ser. 3, vol. 3, p. 93, pl. VI, fig. 4.

What appears to be the original of Dawson's 1862, fig. 20, pl. XIII, is in the McGill University collection, No. 3341. Notwithstanding Dr. Matthew's re-description of the form, I can see in these fragments no character sufficiently well preserved or distinctive for the foundation of a species.

Calamites Cistii, *Brongniart* mut. *Matthew*.

1906. *Calamites Cistii*, Brongt. *mut.* Matthew, Trans. Roy. Soc. Canada, vol. 12, p. 110, pl. III, figs. 1, 2.
1910. *Calamites Cistii*, Borngt. *mut.* Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, pl. 247.

Of the specimen all that can justly be said is that it is an indeterminable "Calamites sp."

Calamites sp. *Dawson.*

1871. *Calamites* sp., Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 27, pl. IV, fig. 49.

The specimen illustrated by Dawson is quite indeterminable.

Calamodendron antiquius, *Dawson.*

1871. *Calamodendron antiquius*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 24, pl. III, fig. 39.

1910. *Calamodendron antiquius*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 247.

The specimen does not show any characters sufficiently distinctive for the foundation of a species.

Calamodendron tenuistriatum, *Dawson.*

1871. *Calamodendron tenuistriatum*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 25, pl. III, fig. 40.

1910. *Calamodendron tenuistriatum*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 247.

The specimen is really indeterminable, and cannot be retained as the basis of a distinct species.

Carpolithes compactus, *Dawson.*

1871. *Carpolithes compactus*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 63, pl. XIX, fig. 229.

1910. *Carpolithes compactus*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 249.

This imperfect and confused fragment is entirely indeterminable.

Cordaites angustifolia, *Dawson.*

1861. *Cordaites angustifolia*, Dawson, Canad. Nat., vol. 6, p. 170, p. 170, fig. 11, *c*.

1862. *Cordaites angustifolia*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 318.

1868. *Cordaites* [illegible]*ustifolia*, Dawson, Acadian Geology, ed. 2, p. 546.

1871. *Cordaite* [illegible]*stifolia*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. [illegible] Rep., p. 44, pl. XIV, fig. 163.

1882. *Cordaites* [illegible]*ustifolia*, Dawson, Foss. Pl. Erian. Upp. Silur. Canada, pt. ii, p. 106.

White in his account of the Pottsville Formation, identifies some specimens from these beds as agreeing with the species figured by Dawson. But, as he points out, the name must be kept for the Gaspe material. This is done by Smith and White (1905) in their account of the Perry basin, and they add (p. 78) "The plants from St. John included by Dawson in the same species represent an entirely distinct type."

The material is exceedingly poor in any case, and not worth description. It is possible that they may be young leaves of *C. Robbii* as White (1900 p. 904) suggests.

Ginkgophyton Leavitti, *Matthew.*

1910. *Ginkgophyton Leavitti*, Matthew, Trans. Roy. Soc. Canada, vol. 12, p. 87, pl. IV.

I have not been able to study the original specimens in sufficient detail to determine them specifically. The attachment of seeds to the foliage does not appear to be established and the foliage itself is too imperfect to found a species upon it. As the basis of a genus it is totally inadequate. Jongmans, 1911, p. 374, in a footnote says: "*Ginkgophyton* n. gen. *Leavitti* n. spec. (ist) wohl ein *Sphenopteris*."

Hymenophyllites Gersdorfii, *Goeppert*, in Dawson.

Plate XXIV, figure 65.

1862. *Hymenophyllites Gersdorfii*, Goeppert, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 322, pl. XV, fig. 37.
1868. *Hymenophyllites Gersdorfii*, Goeppert, Dawson, Acadian Geol., p. 552, fig. 192H.
1871. *Hymenophyllites Gersdorfii*, Goepp., Dawson, Foss. Pl. Devon. Silur. Canada, Geol. Surv. Rep., p. 53, pl. XVI. fig. 182.
1888. *Hymenophyllites Gersdorfii*, Dawson, Geol. Hist. Pl., p. 73, fig. 23H (from 1905 edition).
1910. *Sphenopteris* (?) *Gersdorfii*, Goepp., Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.

The original and only specimen on which this identification is made is shown in fig. 65, pl. XXIV, of the present paper. It will at once be apparent that it is not *Hymenophyllites Gersdorfii*, Goeppert, if reference be made to Goeppert's original figures 1–2, pl. XXXVII, in his Foss. Farnkraût, 1836.

The specimen appears to be simply the tip of a poorly-preserved pinnule of *Diplothmema sub-furcatum* (see p. 37).

Hymenophyllites Hildreti, *Lesquereux in Dawson.*

[? 1858. *Hymenophyllites Hildreti*, Lesquereux in Roger's Geol. Pennsylvania, vol. 2, p. 863, pl. IX, figs. 5, 5a.]
1871. *Hymenophyllites Hildreti*, Lesquereux, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Rep. Geol. Surv., p. 54, pl. XVI, fig. 181.
[? 1880. *Sphenopteris* (*Hymen.*) *Hildreti*, Lesquereux, Coal Flora Pennsylvania, p. 283.]

I have not seen the original of Lesquereux's plant, and as no further specimens have come to hand in the St. John deposits, I cannot supplement Dawson's remarks on his determination. Dawson gives no description of his specimen, merely saying "specimens procured by Mr. Weston at Lepreau appear to belong to the above-named species."

Reference should be made to Dawson's fig. 181, pl. XVI, when it will be obvious that under the circumstances the determination must be regarded as very doubtful.

Odontopteris squamiger, *Dawson* [non Lesquereux].

1881. *Odontopteris squamosa*, Dawson, Quart. Journ. Geol. Soc., vol. 37, p. 305, pl. XIII, fig. 17.
1882. *Odontopteris squamosa* = *Odontopteris Squamigeron* on Erratum slip, Dawson, Foss. Pl. Erian (Devon.) Upp. Silur. Canada, pt. II, p. 114, text, fig. 11.
1910. *Odontopteris squamosa*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.

The description of this fragment given in the second Report on Devonian and Silurian plants is verbatim from the Journal of the Geological Society of the preceding year, and the same figure is reproduced. Reference to this figure and the description shows that the fragment consisted of but a small portion of a compound leaf, in Dawson's words, "Petiole slender, bearing short pinnules placed at right angles to it, and each consisting of two rounded decurrent pinnulae and a terminal pinnule of triangular form." The plant is, therefore, entirely different from Lesquereux's *Odontopteris squamosa* in Roger's (1858) Geology of Pennsylvania, pl. XIX, fig. 2, as is immediately obvious on comparing the two figures. Dawson's name, therefore, is antedated and cannot stand, as he doubtless recognised when he changed it to *O. squamiger* on the erratum slip in 1882. It does not appear necessary to give the fragment another

name, however, for, so far as it goes, it entirely coincides with "*Neuropteris polymorpha*," Dawson, of which it is merely a fragment. (See p. 58).

Pecopteris (Alethopteris) obscura (?), *Lesquereux, in Dawson.*

1862. *Pecopteris* (*Alethopteris*) sp., Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 322, pl. XVI, fig. 49.
1868. *Pecopteris* (*Alethopteris*) *obscura* (?), Lesquereux, Dawson, Acadian Geol., p. 553

Sir William Dawson (p. 322, 1862) points out that this closely resembles Lesquereux's species of *Alethopteris* from the Coal Measures of Pennsylvania. I have no specimen of this species, and have nothing to add to his determination except the remark that Lesquereux's figures were confessedly incomplete, and that when he revises the form in his "Coal Flora," p. 170P, pl. XXXVI, figs. 1, 2, there remains very little likeness to Dawson's fragment.

It must also be noticed that Lesquereux changes the name to *Callipteridium rugosum* in this later (1880) work.

Pecopteris preciosa, *Hartt.*

Plate XXIII, figure 61; plate XXIV, figure 63.

1868. *Pecopteris* (*Alethopteris*) *preciosa*, Hartt, Dawson, Acadian Geol., p. 553, fig. 192L.
1871. *Pecopteris* (*Aspidites?*) *preciosa*, Hartt, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 56, pl. XVIII, figs. 210, 211.
1888. *Pecopteris preciosa*, Hartt, Dawson, Geol. Hist. Pl., p. 73, fig. 23L (in 1905 edition).
1910. *Pecopteris* (*Aspidites?*) *pretiosa*, Hartt, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 248.

This "species" was founded on some fragments of pinnae, and a sketch of a single pinnule was given with the description in "Acadian Geology" by Dawson. In the 1871 monograph, Dawson gives further figures of the form from which it is evident that specimen "B", labelled as "Type" in the McGill University collection, is the original of his fig. 210. A photograph of this specimen is shown in my plate XXIII, fig. 61, where it will be seen that the alteration of the rock has slightly distorted the

specimen, which is consequently too indistinct to show either its outline or its venation exactly. It is, therefore, impossible to determine it reliably, and under no circumstances is it possible to found a new species on such a specimen. All that can be said is that it may be a fragment of *P. plumosa*. The second fragment included in the McGill collection is shown in my plate XXIV, fig. 63. It is labelled as "*Pecopt. preciosa*" in Dawson's writing, as can be seen in the photograph. It does not fulfil the diagnosis for the species in Acadian Geology, p. 553, however. Here Dawson says: "Pinnae a little larger than those of the last species, (i.e. "*P. serrulata*"), not serrated," for in this fragment the pinnules are quite as much serrated as those of "*P. serrulata*."

It is, therefore, clear that the type specimens prove entirely inadequate for the foundation of a species. The name must, therefore, lapse. The fragments forming the type are both indeterminable, but they are possibly (?) *P. plumosa*.

Pinnularia nodosa, *Dawson*.

1871. *Pinnularia nodosa*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Rep. Geol. Surv., p. 33, pl. VII, fig. 78.
1910. *Pinnularia nodosa*, Dawson, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 247.

The type, and only specimen is in the McGill University collection, No. 3330. It has been varnished and, therefore, rendered somewhat obscure, but it is quite evident that it represents merely the obscure and much altered pinnae of a fern.

Ramicalamus dumosus, *Matthew*.

1906. *Ramicalamus dumosus*, Matthew, Trans. Roy. Soc. Canada, vol. 12, p. 115, pl. VIII, figs. 2, 3, 4, 5.
1910. *Ramicalamus dumosus*, Matthew, Bull. Nat. Hist. Soc. New Brunswick, vol. 6, p. 247.

Dr. Matthew's sketch of this form, reproduced in his plate VIII, fig. 2, indicates all that can be seen in the type specimen, which he kindly showed me. It appears to me quite impossible to give a diagnosis that would suffice to define a *species* on such material.

Sphenophyllum innocens, *Matthew*.

1910. *Sphenophyllum innocens*, Matthew, Trans. Roy. Soc. Canada, ser. 3, vol. 3, p. 96, pl. VI, fig. 8.

In the words of Jongmans, 1911, p. 374, "Die dritte neue "Art" *S. innocens* wird wohl am besten den absolut unbestimmbaren Resten zugerechnet."

Sphenopteris Hartii, *Dawson*.

1862. *Sphenopteris Harttii*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 321, pl. XVI, fig. 48, *a* and *b*.
1868. *Sphenopteris Harttii*, Dawson, Acadian Geol., ed. 2, p. 551, fig. 192E.
1871. *Sphenopteris Harttii*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 52, pl. XVI, figs. 176, 177.
1888. *Sphenopteris Harttii*, Dawson, Geol. Hist. Pl., p. 73, fig. 23E (from the 1905 reprint).
1910. *Sphenopteris Harttii*, Dawson, Matthew, Bull. New Brunswick Nat. Hist. Soc., vol. 6, p. 248.

The fragment illustrated in 1862, fig. 48, pl. XVI, is the same as that given in the 1871 monograph, and the other cuts of the species. Although these drawings appear to differ very much from Dawson's drawings of *Hymenophyllites sub-furcatus*, comparison with specimens slightly distorted by movement of the matrix (as is common in the St. John shales) convinces me that the original of the supposed *S. Hartii* is no more than a fragment of *Diplothmema sub-furcatum* (see p. 37).

Sphenopteris Hitchcockiana, *Dawson*.

1862. *Sphenopteris Hitchcockiana*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 321, pl. XVI, fig. 51, *a*, *b*, *c*.
1868. *Sphenopteris Hitchcockiana*, Dawson, Acadian Geol., p. 552 (doubtful fragments.)

This "species" was recognised by Schimper (vol. 1, p. 478) as the fructification of *Archaeopteris*. The original was from the Perry basin, and the plants are fully described by Smith and White (1905, p. 45) in their recent paper on the district. In his original description Dawson (1862, p. 321) says that an "immense number of leaflets, apparently of this species, are scattered over certain surfaces of the St. John shales, but have not yet been seen in connexion with their rachis." Later, in his Acadian Geology (p. 552) he says that "Doubtful fragments

only occur." This later view appears to be correct and indeed, judging from the specimens said to represent it, which I have had the privilege of examining, there is no real evidence for the existence of this species in the St. John beds.

Sphenopteris obtusilobus, *Goeppert*, in Dawson.

Plate XXIV, figure 64.

1862. *Hymenophyllites obtusilobus*, Goeppert, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 322 (pl. XV, fig. 39, in description of plates, error for *H. curtilobus* ?).
1868. *Hymenophyllites obtusilobus*, Goeppert, Dawson, Acadian Geol., p. 552.
1871. *Sphenopteris obtusilobus*, Goeppert, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 53, pl. XVI, fig. 183.

It will at once be seen on reference to the photograph (pl. XXIV, fig. 64 present paper) of Dawson's original and only specimen of this "species" that it bears no resemblance to the European *H. obtusilobus*. This is labelled in Dawson's writing as "Type, H. Obtusilobus," and is the original of his fig. 183, pl. XVI, in 1871. The names *obtusilobus* and *curtilobus* were confused in 1862, but the monograph in 1871 makes it clear that "*obtusilobus*" is named from the specimen now photographed, (No. 3318 McGill University coll.) This is merely a fragment of *Diplothmema sub-furcatum* as is evident from a study of the actual specimen, which is somewhat altered. (See p. 37).

Sphenopteris (Hymenophyllites) curtilobus, *Dawson*.

1862. *Hymenophyllites curtilobus*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 321 (pl. XV, fig. 39, in text. This is *H. obtusilobus* in desc. of figures).
1868. *Hymenophyllites curtilobus*, Dawson, Acadian Geol., p. 552, fig. 192G.
1871. *Hymenophyllites curtilobus*, Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 53, pl. XVI, figs. 178-179.
1888. *Hymenopyhllites curtilobus*, Dawson, Geol. Hist. Pl., p. 73, fig. 23G (1905 edition).

The two figures in the 1871 description of this species appear to bear no relation to that (pl. XV, fig. 39) of the 1862 memoir referred to in the text as an illustration of *Hymenophyllites curtilobus*. In the description of the figures, this illustration is quoted as *Hymenophyllites obtusilobus*. It seems probable that as a result of some confusion in arranging his printer's slips, the species names and descriptions may have got mixed and the

specific name perpetuated accidentally. In both the Acadian Geology and the Geological History of Plants the same figure appears as *H. curtilobus* which is quoted as *H. obtusilobus* in the original description of the illustration.

I have not located the original specimens of either of the figures of the 1871, or the 1862 illustration of the species. The type specimens therefore being in such confusion, and probably unavailable, and the illustrations indicating that, whichever form they were, they were very fragmentary and far from characteristic, it seems much wiser to abolish the "species" *curtilobus* altogether.

Trichomanites *sp. Dawson.*

1862. *Trichomanites* (?), Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 322, pl. XVI, fig. 50, *a*, *b*.
1871. *Trichomanites* sp., Dawson, Foss. Pl. Devon. Upp. Silur. Canada, Geol. Surv. Rep., p. 56.

Dawson (1862) says of this specimen: "A minute frond, collected at St. John by Mr. Hartt, may possibly represent a plant of this genus; but it may be merely the nervures of a leaf whose parenchyma has been removed by decay". There is no doubt that Dawson's second alternative is the correct one.

Trigonocarpum Dawsonianum, *D. White.*

1871. "Fruits or bracts of uncertain nature," Dawson, Foss. Pl. Devon, Upp. Silur. Canada, Rep. Geol. Surv. Canada, p. 64, pl. XIX. figs. 230*a* (not 230), 231, 231*a* and *b*.
1899. *Trigonocarpum Dawsonianum*, David White, Pottsville Formation, p. 910.
1900. *Trigonocarpum Dawsonianum*, David White in Ami, Ottawa Naturalist, vol. 14, p. 123.

Dawson gives no description of the fragments he figures, but reference to his plate XIX will show how imperfect they are. David White (1899, p. 910) in his account of the Pottsville formation does not describe them either, nor does he further illustrate them. His account is as follows:—"Accompanying the specimens of a very narrow and rather small *Trigonocarpum*, there occur in the same matrix numerous detached valves which agree so completely with the fragments figured by Dawson from the "Fern Ledges" at St. John as "fruits or bracts of uncertain

nature" that I have ventured to include a portion of the latter material as well, in the same species. The figures given in the "Devonian Flora" will serve to illustrate the Pottsville material which I name in honour of the late distinguished palaeobotanist of America."

As I have not seen any of the Pottsville material, I am not in a position to comment on this species as represented from those beds, but regarding the St. John plants which "serve to illustrate the Pottsville material" I must state that I find it impossible to accept the fragments as a true species and still more so to utilise them for the basis of comparison with another flora.

TRIGONOCARPUM RACEMOSUM, *Dawson.*

1862. *Trigonocarpum racemosum*, Dawson, Quart. Journ. Geol. Soc., vol. 18, p. 324, pl. XVI, fig. 47, *a*, *b*, *c*.

1868. *Trigonocarpum racemosum*, Dawson, Acadian Geol., ed. 2, p. 555, fig. 194E.

1871. *Trigonocarpum racemosum*, Dawson, Foss. Pl. Dev. Upp. Silur. Canada, Geol. Surv. Rep., p. 62, pl. XIX, fig. 2?

1888. *Trigonocarpum racemosum*, Dawson, Geol ... Plants, p. 82, fig. 31E (from the 1905 edition.)

The original specimens of the fragments figured in the 1862 paper are in McGill University collection, No. 3273. These are poorly preserved fragments of *Cordaianthus*. The impression illustrated in fig. 227a, pl. XIX, in the 1871 account suggests that it may be the Westphalian form *Samaropsis Pitcairniae* (Lindley and Hutton) but it is too imperfect for identification.

Tabular list of old and new names applied to the St. John plants.

It may be convenient for some readers to have a list of the older names of the St. John plants with the determinations made in the present paper:—

Older names of Dawson, Matthew, etc.	*Present names.*
THALLOPHYTA.	
Rhizomorpha lichenoides Matt.	Fern aphlebia.

Older names.	*Present names.*
EQUISETALES.	
Calamites transitionis Dawson.	
Astrocalamites scrobiculoides Matt.	*Calamites* sp.
Calamites Suckowi Brongt.	*Calamites Suckowi* Brongniart.
C. cannaeformis Schl.	
C. Cistii Brongt. mut. Matthew.	*Calamites* sp. indeterminable
C. geniculosus Matt.	*Calamites* sp.
Lepidocalamus scutiger Dn. sp.	Indeterminable.
Ramicalamus dumosus Matt.	Indeterminable.
Calamodendron antiquius Dn.	Indeterminable.
C. tenuistriatum Dn.	*?Calamites Suckowi* Brongniart.
Asterophyllites parvulus Dn.	*Asterophyllites parvulus*, Dn. (?=*A. grandis* Sternb.)
A. parvulus var. Matt.	
A. fasciculatus Matt.	*A. longifolia*, i.e. *Annularia stellata* Schl. sp.
A. lentus Dn.	*Asterophyllites* sp. (=*A. radiata?*).
A. fissus Matt.	*Asterophyllites equisetiformis* Schl.?
Annularia latifolia Dn. sp.	=*Annularia latifolia* Dn. sp. (=*A. stellata* Schl. sp.?)
A. latifolia mut. minor Matt.	*Annularia latifolia* Dn. sp. (=*A. stellata* Schl. sp.?)
A. acicularis Dn. sp.	*Asterophyllites acicularis* Dn. sp. (=*A. equisetiformis?*)
A. lenta Dn. sp.	*Asterophyllites lentus* Dn. (?=*Annularia radiata*).
A. recurva Matt.	Indeterminable.
A. ligita Matt.	Indeterminable.
Pinnularia dispalans Dn.	*Pinnularia dispalans* Dn.
P. elongata Dn.	*Pinnularia elongata* Dn.
P. nodosa Dn.	Fern frond, distorted.
Sporangites acuminata Dn.	*Sporangites acuminata* Dn.

Older names.	*Present names.*
SPHENOPHYLLALES.	
Sphenophyllum antiquum Dn.	*Sphenophyllum antiquum* Dn.
S. gemma Matt.	*? Sphenophyllum cuneifolium* Sternb. sp.
S. latum et var. minus. Matt.	*? Sphenophyllum cuneifolium* Sternb. sp.
S. innocens Matt.	Indeterminable.
LYCOPODIALES.	
Sigillaris palpebra Dn.	*Sigillaria* sp.
Stigmaria perlata Dn.	*Stigmaria ficoides* Brongn.
Lycopodites Matthewi Dn.	*Lepidodendron* sp. foliage.
Cyperites sp. Dn.	*Lepidodendron* or *Sigillaria* leaves.
PTERIDOPHYTA.	
Psilophyton elegans Dn.	*Psilophyton elegans* Dn.
?P. glabrum Dn.	*Dicranophyllum glabrum* Dn. sp.
Aneimites obtusa Dn.	*Adiantides obtusus* Dn. sp.
Aneimites (Triphyllopteris) valida Dn.	*Sphenopteris valida* Dn. sp. (=*S. artemisiaefolioides* Crépin).
Ginkgophyton Leavitti Matt.	*Sphenopteris* sp.
Pseudobaiera McIntoshi Matt.	*Rhacopteris Busseana* Stur.
P. McIntoshi mut. flabellata Matt.	*Rhacopteris Busseana* Stur.
Sphenopteris marginata Dn.	*Sphenopteris marginata* Dn. (=*S. rotundifolia* Andrä).
S. Harttii Dn.	*Diplothmema subfurcatum* Dn. sp.
S. splendens Dn.	*Oligocarpia splendens* Dn. sp.
S.(Hymenophyllites) curtilobus Dn.	No basis for name.
S. subfurcatus Dn.	*Diplothmema subfurcatum* Dn. sp.

Older names.	*Present names.*
S. Gersdorfii Goepp	*Diplothmema subfurcatum* Dn. sp.
Alethopteris ingens Dn.	*A. lonchitica* Schl. sp.
A. Perleyi Hartt.	Indeterminable.
Alethopteris decurrens Dn.	*Alethopteris lonchitica* Schl. sp.
Alethopteris discrepans Dn.	
Johannophyton discrepans (Dn.) Matt.	
J. discrepans var.	
Neuropteris polymorpha Dn.	*Neuropteris heterophylla* Brongniart.
N. retorquata Dn.	*Neuropteris gigantea* Sternb.
N. serrulata Dn.	*Pecopteris plumosa* Artis.
N. crassa Dn.	*Neuropteris gigantea* Stern.
N. Selwyni Dn.	*Neuropteris Selwyni* Dn. (? = *N. Schlehani* Stur.)
Cyclopteris varia Dn.	Part = *Neuropteris* sp. cf. *N. impar.*
Nephropteris (Odontopteris) varia (Dn.) Matthew.	Part = *Cyclopteris varia* Dn.
Cyclopteris Brownii Dn.	*Cyclopteris Brownii* Dn.
Nephropteris problematica Dn.	
Odontopteris squamosa or squamiger Dn.	*Neuropteris heterophylla* Brongn.
Megalopteris Dawsoni Hartt sp.	*Megalopteris Dawsoni* Hartt sp.
Cardiopteris eriana Dn.	*Neuropteris eriana* Dn. sp.
Callipteris pilosa Dn.	*Pecopteris Miltoni* Artis. sp.
Pecopteris (Aspidites?) serrulata Hartt	*Pecopteris plumosa* Artis.
P. (Aspidites?) preciosa Hartt.	Indeterminable.
P. (Cyathites?) densifolia Dn.	*Pecopteris Miltoni* Artis. sp.
Whittleseya Dawsoniana D. White	*Whittleseya Dawsoniana* D. White.
W. concinna and varr. Matt.	*Whittleseya concinna* Matt.
Trigonocarpum Dawsonianum D. White	St. John examples indeterminable.

Older names.	*Present names.*
Trigonocarpon racemosum Dn.	*Cordaianthus* sp.
T. perantiquum Dn	*Trigonocarpum perantiquum* Dn.

GYMNOSPERMS.

Dadoxylon Ouangondianum Dn.	*Dadoxylon Ouangondianum* Dn.
Cordaites Robbii Dn.....	*Cordaites Robbii* Dn. (pars = *C. borassifolius* and *C. principalis*).
C. Robbii narrow var Dn.....	*Poacordaites* sp.
Cardiocarpon cornutum Dn....	*Cardiocarpon cornutum* Dn.
C. Baileyi Dn.....	*Cardiocarpon Baileyi* Dn.
C. Crampii Hartt.....	*Cardiocarpon Crampii* Hartt.
C. ovale Dn.....	*Cardiocarpon ovale* Dn.
C. obliquum Dn.....	*Cardiocarpon obliquum* Dn.
Carpolithes compactus Dn.....	Indeterminable.
Antholithes Devonicus Dn....	*Cordaianthus devonicus* Dn. sp.
A. floridus Dn.....	*Cordaianthus devonicus* Dn. sp.

CHAPTER III.

GEOLOGICAL CONCLUSIONS FROM THE PRECEDING EVIDENCE.

RELIABLE DETERMINATIONS.

Those who have read or glanced through the section of this work devoted to the "Doubtful or Indeterminable plants" will have noticed what a large number of them there are, and will have been prepared, therefore, for the sweeping reduction in the number of the species in the St. John flora which I must make.

Though over eighty "species" have been from time to time described from the "Fern Ledges" flora of St. John, I find among all these only about forty that are of value and that are determined on a sufficiently sound basis to make them of any real use in the comparison of this flora with others. Of course, from exceedingly poorly preserved remains, it is often possible to make a shrewd guess as to the species contained in a series of beds, and consequently as to their age, but for the foundation of new species such material is valueless. In too many cases have the merest scraps of half-preserved debris been utilised for the types of new species in the St. John deposits, and these names and determinations have been adopted, often without sufficient examination, by other writers.

While every palaeontologist knows that many "species" and often very good ones for stratigraphic purposes, are merely single organs of forms which are incompletely known, and consequently "good species" are not obtainable in the modern sense of the word; nevertheless there is a certain standard (which it is difficult to define, but which a competent palaeobotanist can recognise) that specimens must reach before they can be reliably determined. In my opinion the only species which are represented in the St. John flora which approach that standard are included in the following list. Consequently the plants in the following list are the only ones of which I shall make serious use in comparisons of this flora with those from other parts of the world, though some corroborative evidence lies in the poorly preserved remains.

Calamites Suckowi Brongnt.
Annularia sphenophylloides Zenker.
Annularia stellata Schlotheim sp.
Annularia latifolia Dawson sp. (=*A. stellata?*)
Stigmaria ficoides.
Adiantides obtusus Dawson sp.
Rhacopteris Busseana Stur.
Sphenopteris marginata Dawson (=*S. rotundifolia Andrä*).
Oligocarpia splendens Dawson sp. (=*O. Brongniarti* Stur).
Sphenopteris valida Dawson sp. (=*S. artemisiaefolioides.* Crépin).
Pecopteris plumosa Artis.
Diplothmema subfurcatum Dawson sp.
Alethopteris lonchitica Schlotheim sp.
Megalopteris Dawsoni Hartt sp.
Neuropteris heterophylla Brongniart.
Neuropteris gigantea Sternberg.
Sporangites acuminata Dawson.
Pterispermostrobus bifurcatus Stopes.
Dicranophyllum glabrum Dawson sp.
Whittleseya Dawsoniana D. White.
Whittleseya concinna Matthew.
Cordaites Robbii Dawson (cf. *S. borassifolius* Sternb.).
Cordaites principalis German sp.
Dadoxylon Ouangondianum Dawson.
Cordaianthus devonicus Dawson sp.
Cardiocarpon obliquum Dawson.
Cardiocarpon Baileyi Dawson.
Cardiocarpon cornutum Dawson.
Cardiocarpon Crampii Hartt.

To this list should be added the following, in which there may be uncertainty about the specific identity, but of which the *genus* is certain, and is of some stratigraphic significance:—

Calamostachys sp.
Asterophyllites acicularis Dawson =*?A. equisetiformis* Schl.
Asterophyllites parvulus Dawson =*A. grandis* Sternb.*?*
Sphenophyllum antiquum Dawson.

Sphenophyllum ?cuneifolium Sternberg. sp.
Lepidodendron sp. foliage.
Lepidodendron sp. (in "Bergeria" condition).
Sigillaria sp.
Neuropteris Selwyni Dawson. = *?N. Schlehani* Stur.
Neuropteris eriana Dawson sp.
Poacordaites sp.
Sternbergia sp. (pith casts of *Cordaites*).

This list may appear very short, and the number of species exceedingly small to be all that represents the rich flora of the Fern Ledges of St. John, but those who will give the "species" I have discarded serious attention, and will trouble to look up the original specimens and illustrations, cannot fail to recognise, if they judge impartially, that no good purpose can be served by retaining them. It is deplorable though none the less true that many palaeobotanists have slipped into the easy habit of naming as a new or distinct species imperfect or troublesome fragments, and thus different parts of a single frond have been given different specific names, and I have found actually a case (not of Palaeozoic plants) where a single fossil and *its own reverse* are put in different genera!

By such means, though the lists of "species" described from various localities has been swelled to important proportions, the science of palaeobotany has suffered grievously in repute among geologists and other scientists who use its results. Hence I cannot recognise species founded on very poor material. It seems a better thing to be blamed for ignoring obscure species and failing to recognise the specific names of indeterminable fragments, than to pad lists with "species" which posterity will deride.

I recognise that the names in my carefully selected and sifted list may be changed to suit different interpretations of the rules of nomenclature and in any case some of them may not stand against the results that we hope will accrue in the next twenty years, for by that time many scattered fragments will be pieced together and we may then know as whole plants what we now know only as separate parts under temporary "specific"

names. Nevertheless, I trust that the actual plants now recorded under the above names are recognisable in themselves and can therefore be used safely in comparisons of the St. John flora with similar fossil floras from other parts of the world.

GEOLOGICAL CONCLUSIONS.

Before entering into a consideration of the geological position of the Little River Fern Ledges flora it will be well to decide whether we are dealing with a single flora, or with a consecutive series of floras comparable with the whole of the Pottsville for instance, of which Mr. David White writes (1895, p. 307) that the flora was changing rapidly, and "In the lower part of the Pottsville series many species show a relation to the floras of the Vespertine or Calciferous Sandstone series; in the middle portion many of the forms are unique, while in thickly developed sections it is only near the top of the series that we see occasional Coal Measure forms creeping in."

To get such data for the Fern Ledges flora it is necessary to have carefully collected series of fossils with the actual beds of origin recorded for each species. Some such collections were made and the results published as long ago as 1865 by Prof. Hartt. He described eight plant beds, giving the species found in each. Since then many further plants have been found, but in very few instances has their exact location been recorded. But, as will be seen in the following analysis of Hartt's records, important and sufficient evidence was accumulated by him to prove that we are dealing with what may be taken, broadly, as a single flora.

Analysis of Plant Beds, Nos. 1–8, described by Hartt (1865, p. 134–139).

(The numbers in brackets are the numbers of Hartt's beds).

Calamites transitionis, (1), (2), (3), (4), (6), (7), (8).

Calamites cannaeformis (i.e. *C. Suckowi* Brongniart), (2), (3), (5), (6), (7), (8).

Asterophyllites latifolia, (1), (2), (3).

A. acicularis, (1), (2), (5), (7), (8).

A. parvulus, (2).

A. longifolia, (1), (2).

A. scutigera, (1). Matthew records from (2) and others.

Pinnularia dispalans, (2), (3), (4), (7), (8).

Sphenophyllum antiquum, (1) (Hartt, only a single specimen). Matthew for highest shale bed of Dadoxylon sandstone.

Psilophyton glabrum (i.e. *Dicranophyllum glabrum*), (2), (3), (4), (5).

Psilophyton elegans, (1), (2), (3), (7).

Pecopteris obscura, (1), (rare).

Sporangites acuminata, (2), (3), (7), (8).

Cyclopteris obtusa, (2), (3), (7), (8).

Cyclpoteris varia, (2).

Sphenopteris marginata (=*S. rotundifolia*), (2), (3), (5), (7).

Sphenopteris Harttii, (2).

Sphenopteris Hoeninghausi, (2), (3).

Sphenopteris pilosa (i.e. *Pecopteris Milloni*), (7).

Hymenophyllites subfurcatus, (7), (8).

Megalopteris Dawsoni, (4), (confined to this bed ?)

Neuropteris polymorpha (i.e. *N. heterophylla*), (2), (3), (4), (5), (6), (7), (8).

Neuropteris serrutata (i.e. *Pecopteris plumosa*), (2).

Alethopteris discrepans (i.e. *A. lonchitica*), (2), (3), (5), (6), (7), (8).

Cordaites Robbii (=*C. borassifolius* ?), (2), (3), (4), (5), (6), (7), (8) (never in 1 ?).

Cardiocarpum cornutum, (1), (2), (3), (6), (7), (8).

Cardiocarpum obliquum, (3), (6), (7), (8).

Cardiocarpum Baileyi, (confined to ?) (4).

Cardiocarpum Crampii, (8).

To these may be added:—*Rhacopteris Busseana* (*Pseudobaiera McIntoshi*, Matthew). Matthew's record is from a "thin bed of shale 200 ft. below summit of Dadoxylon sandstones at Duck Cove." A variety in bed (2) of Hartt's series. I found fragments of this in two or three beds at Duck cove.

For convenience of reference it will be well to select the principal species from Hartt's series, under their modern names:

Calamites sp. (compared to *Asterocalamites serobiculatus*, but not this species), (1), (2), (3), (4), (6), (7), (8).
Calamites Suckowi, (2), (3), (5), (6), (7), (8).
Annularia stellata, (1), (2), (3).
Asterophyllites equisetiformis, (1), (2), (5), (7), (8).
Dicranophyllum glabrum, (2), (3), (4), (5).
Sporangites acuminata, (2), (3), (7), (8).
Adiantides obtusus, (2), (3), (7), (8).
Sphenopteris marginata = *S. rotundifolia*, (2), (3), (5), (7).
Pecopteris Miltoni, (7).
Diplothmema subfurcatum, (7), (8).
Megalopteris Dawsoni, (4).
Neuropteris heterophylla, (2), (3), (4), (5), (6), (7), (8).
Pecopteris plumosa, (2).
Alethopteris lonchitica, (2), (3), (5), (6), (7), (8).
Rhacopteris Busseana, (2).
Cordaites Robbii (= *C. borassifolius* ?), (2), (3), (4), (5), (6), (7), (8).
Cordaites principalis, (2), (3), (4), (5), (6), (7), (8).
Cardiocarpon cornutum, (1), (2), (3), (6), (7), (8).

In the above list, several of the species most important for stratigraphic purposes appear. *Neuropteris heterophylla* and *Alethopteris lonchitica* occur from beds (2) right through to beds (8). *Cordaites principalis* and *C. borassifolius* (*Robbii*) occur in all the beds from (2) to (8) and though *Cordaites* is mentioned by Hartt as not appearing in bed (1), yet *Cardiocarpon cornutum*, which most probably belongs to it, occurs in both (1) and (8), and most of the intermediate beds. *Calamites Suckowi* occurs from (2) to (8), and other species in all the series. *Sphenopteris marginata* (= *S. rotundifolia*) is recorded from beds (2) to (7), *Sporangites* from (2) to (8), and *Dicranophyllum glabrum* from beds (2) to (5). This is interesting, for *Dicranophyllum* is looked on as mainly a Stephanian genus, and might be taken as an indication of the higher position in the Carboniferous of the series, but it occurs in beds below *Megalopteris Dawsoni*, which is a leading Pottsville type. Then again, *A. stellata*, indicative of, at least, upper and middle Westphalian, is found at the

very base of the series of beds. But most of the important plants are mixed in all the beds.

Personally (ref. p. 9) I found it impossible to confine the series to 8 beds, for I found more than twice as many as this at Duck cove, and in them the plants were even more mixed than in the table given by Ami.

The distribution of the forms mentioned, however, occurring from the bottom to the top of the series, leaves no room for doubt that the Fern Ledges plants are a single flora, in the sense that they represent a period of time no longer than a single main division of the Carboniferous. Dr. Matthew's separation into three sub-floras (see 1906, pl. 101, et seq.) appears to me to be without stable foundation.

We must now consider *which* period in the Carboniferous epoch they represent. After the determinations of the plants given in the other sections of this memoir, it would be mere waste of time here to argue elaborately why this flora must be Carboniferous, for every species of importance is a typical Carboniferous one. As will be remembered (ref. p. 5 et seq.) both Dr. Kidston and Mr. David White, as well as other palaeobotanists were agreed as to the Carboniferous age of the plants, though Mr. White correlated them with his American Pottsville and Dr. Kidston with the European Lower Coal Measures. As Mr. White pointed out (1901 A) the apparent discrepancy in this was greater than the actual, for he considers that the upper part of the Pottsville is very nearly contemporaneous with the Lower Coal Measures of Europe.

As from the nature of the characteristic plants of the Fern Ledges it is only with the very uppermost zones of the Pottsville that the comparison can be made (ref. to passage quoted from White ante p. 5) so that while agreeing in the main with Mr. White's conclusions, I confess that the St. John Fern Ledges seem to represent a somewhat higher zone than he allows in his correlation of his Pottsville series. Mr. White gives the following species (which are quoted also from him by Dr. Ami) as being common to the American Pottsville and the Fern Ledges of St. John. I add a few comments to some of the determinations.

Species given by White as common to Pottsville and Fern Ledges of St. John.

Annularia acicularis Dn. sp.

Annularia laxa Dn.

Annularia latifolia (Dn.) Kidston.

Asterophyllites parvulus Dn.

Sphenopteris Hartii Dn. (Dawson's original was a distorted fragment of *D. sub-furcatum* ref. p. 105 ante).

Sphenopteris pilosa Dn. (=*Pecopteris Miltoni*, which species White records from the Pottsville).

Pecopteris serrulata Dn. (=Pecopteris plumosa).

Megalopteris plumosa D. White (a form closely resembling *M. Dawsoni* from St. John).

Neuropteris Pocahontas D. White (compare this with *Cardiopteris eriana* Dn. (see p. 61 ante), which I think was probably *N. heterophylla* fragments).

Neuropteris retorquata (i.e. *N. gigantea*).

Alethopteris discrepans Dn. (i.e. *A. lonchitica*, see p. 47 ante).

Alethopteris ingens.

Cordaites Robbii Dn. (=*C. borassifolius*?).

Cordaites angustifolia Dn. (This species was later eliminated, see Smith and White, 1905).

Cardiocarpon cornutum Dn.

Cardiocarpon obliquum Dn.

Cardiocarpon Girtyi White, (closely allied to *C. Baileyi Dn.*).

Trigonocarpon Dawsonianum D. White (named to include indeterminable fragments described by Dawson).

Before discussing this it will be useful to have a table of the principal species from the St. John beds arranged so as to show their distribution both in the Pottsville and in the Westphalian series of the European Coal Measures, with which there is a most striking similarity. In the following list I give only the more securely determined, and the plants more important for stratigraphic purposes.

Principal species as determined in the present paper, in the "Fern Ledges" Flora of St. John.

	Westphalian of Europe.	Pottsville of America.	Missouri beds of America.	Remarks.
Calamites Suckowi	x	x	x	In all Coal Measure series in England.
Annularia sphenophylloides	x	x	x	..
Annularia stellata	x	x	x	..
Asterophyllites acicularis (=*equisetiformis ?*)	(x)	x	x	..
Asterophyllites parvulus (=*grandis ?*)	(x)	x	..	..
Sphenophyllum cuneifolium (?)	x	x	x	Very scarce indeed in St. John beds.
Sphenopteris marginata (=*rotundifolia*)	(x)	G	(cf=*Lacoei*)	..
Sphenopteris valida (=*artemisiaefolioides*)	(x)	G	G	..
Diplothmema sub-furcatum (=*furcatum*)	x	(x)	G	Plentiful in St. John beds
Oligocarpia splendens (=Brongniarti)	(x)	(x)	(x)	..
Pecopteris Miltoni	x	x	G	..
Pecopteris plumosa	x	(x)	G	Plentiful in St. John beds
Rhacopteris Busseana	x	..	..	..
Adiantides obtusa	(x)	..	..	..
Megalopteris Dawsoni	..	G	..	Very similar species in Pottsville.
Neuropteris heterophylla	x	(x)	..	Very frequent in St. John beds.
Neuropteris gigantea	x	x	G	..
Neuropteris Schlehani (doubtful).		(x?)	G	Only 2 or 3 specimens, doubtful.
Alethopteris lonchitica	x	x	G	Exceedingly common in St. John beds.
Dicranophyllum glabrum	G	..	G	..
Whittleseya Dawsoniana	G	G	..	A typical Carboniferous genus characteristic of N. America. *W. Dawsoniana*, very close to *W. elegans* from Upp. Pottsville.
Whittleseya concinna	G	G	..	..
Cordaites Robbii (=borassifolius ?)	(x)	x	(x)	Excessively numerous in St. John beds.
Cordaites principalis	x	G	G	..
Cordaianthus devoncus	G	G	G	..
Cardiocarpon obliquum	G	x	G	..
Cardiocarpon Baileyi	G	(x)	G	*C. Girtyi* in Pottsville very similar.
Cardiocarpon cornutum	(x)	x	G	Numerous specimens in all the St. John beds.

In the above Table, x means that the identical species is present; (x) that an exceedingly similar if not identical species is present; and G that other species in the genus are present (some of which may be the same) in the beds with which the comparison is made.

In addition to these species such genera as *Sigillaria, Lepidodendron, Stigmaria, Poa-cordaites, and "Sternbergia"* add to the characteristically Carboniferous facies of the flora; and *S. Hoeninghausi* so exceedingly characteristic of the Westphalian, is reported though its determination is not very sure. Even a cursory glance down the above list will suffice to impress on one how remarkably Westphalian is the flora of the Fern Ledges. The genus *Megalopteris* alone is entirely unrepresented in the Westphalian of Europe, but it is a peculiar form which is confined apparently (though recently Arber identified a small fragment from the British Coal Measures as belonging to this genus) to North America, where it has been recognised in beds of undoubted Pottsville age. Otherwise the leading species have not merely allies in the Westphalian flora of Europe, but are identical in the majority of cases. We may take it then as indisputable that the *Fern Ledges flora* is of *Westphalian age.*

The magnificent and detailed work of M. Zeiller on the Valenciennes basin, and other minute work on British and European Coal Measures, has resulted in the division of the Westphalian into three zones. To quote M. Zeiller (1895, p. 487) "La zone inférieure...à flore relativement pauvre, différant de celle de la zone moyenne par l'absence d'un grand nombre d'espèces fréquentes dans cette dernière, plutôt que par la présence d'espèces particulières; elle est toutefois charactérisee par la grande abondance des *Sphenopteris Hoeninghausi, Alethopteris lonchitica, Neuropteris Schlehani, Bothrodendron punctatum* et *Sigillaria elegans.*" But with none of M. Zeiller's zones does the "Fern Ledges" entirely coincide, for species from the higher zones in considerable numbers of individuals are mixed with those which might otherwise be taken to indicate that it corresponds with the lowest of the Westphalian zones. The explanation of the mixture of the flora and the key to some of the difficulties of the Fern Ledges flora depend on the fact (which seems evident from the arrangement of the beds *in situ* and the

type of debris they contain), that the flora did not grow in the place where it is now found (see p. 10 ante). There is good reason to believe that the Fern Ledges flora is made up of fragments brought down from some inland of higher level, mingled with those of plants growing on the flats through which the stream passed.

Speaking of the beds in Nova Scotia which we may safely take as being nearly, if not absolutely equivalent to the St. John Fern Ledges, Ami (1901, p. 182A) said "It would appear that in Nova Scotia the Carboniferous period began with shallow water conditions, producing the shales, sandstones, mudstones, marls and grits of the Riversdale and Union series. The frequent ripple-marked and littoral character of these beds seems to indicate rapid submergences at the time of deposition and accounts for their great thickness." A little farther west, where now the Fern Ledges of New Brunswick are to be found, I picture that at that time there was a similar condition of rapid submergence in the great delta or lake into which a river brought down the debris of what we now call the Fern Ledges flora. The fact that some of these fragments appear to belong to higher zones than others is thus simply accounted for, because, as detailed work on the Lower Coal Measure series in Britain has shown, the highland flora differed from the swamp flora, and the former included a number of forms generally considered to be of higher Carboniferous, and some even of Permian facies. (See Scott, 1906, Stopes, 1906, and Stopes and Watson, 1908).

This interesting and important result was primarily established in relation to material of which the internal structure was known, but it obviously applies also to the plants represented only by surface impressions.

Hence, in conclusion, we may take it that the Fern Ledges represent plant debris from differing ecological situations which were all growing in that period of time in the Coal Measures which is best known as the *Westphalian*, and that probably it corresponds in point of time most nearly to the lowest zone of the middle Westphalian.

The specific identity between so many of the plants from Europe and Canada is a point of great interest in relation to the geographical distribution of the forms.

As regards the composition of the flora, a point immediatel" noticeable is the extraordinary scarcity of both *Sigillaria* and *Lepidodendron*. Of these no recognisable species occurs and but a small number of specimens that are identifiable generically. This is all the more remarkable because in some of the beds *Calamites* remains are common, so that all members of the "swamp flora" are not entirely absent. At the same time we notice a similar scarcity of *Sphenophyllum*, another of the typical swamp-growing forms of the Coal Measures, and one must take it that we are not dealing with the typical, mixed swamp-flora of the Coal Measures but with one principally growing on dry land. The beds of *Calamites* alternating with others of mixed debris indicate that there were groves of *Calamites* growing as an almost "pure formation" (in the language of the ecologist) just as modern *Equisetum* often does to-day. Another genus whose absence is remarkable is the common *Mariopteris*. The lack of this in a flora containing so many other typical Westphalian "ferns" is particularly noticeable, and raises interesting questions regarding the geographical distribution of species at this time. Until, however, further data are available, it seems to me premature to make generalisations on the theme, however enticing.

Personally, I think it will prove exceedingly difficult, if not impcssible, to attain to any fine zoning in the Fern Ledge flora, but if such work could be attempted by anyone on the spot it would be interesting, and, at least, would result in the gathering of more data and better specimens.

Now a word must be said regarding the relation of these beds to the famous Carboniferous section at Joggins which extends from the bottom to the top of the Carboniferous series. The specimens of *Alethopteris lonchitica* (ref. ante. p. 51) of the "*discrepans*" type which I obtained at Joggins exactly agree with the St. John plants. Furthermore, several species of seeds, and ferns, and *Cordaites* also agree completely from the two series of beds. Reference should be made to the account of the Joggins section in Acadian Geology, pp. 156 et seq, where frequent mention is made of *Calamites Suckowi*, *Alethopteris lonchitica*, *Cordaites borassifolius* and other forms found in the St. John beds; from Joggins also the species of *Cordaianthus* and some

of the seeds described by Dawson are very similar to the Fern Ledge specimens. I understand that Mr. W. A. Bell of the Canadian Survey is re-examining the Joggins section, so that the detailed comparison of the St. John beds with those at Joggins must await his results. It is obvious, however, that the St. John beds being of Coal Measure age, represent merely a different local *facies* of a portion of the Joggins section.

STRATIGRAPHY OF THE ST. JOHN "FERN LEDGES."

There are only three alternatives which need to be considered. The first that the beds are *Devonian*, as first suggested by Sir W. Dawson, and supported for a long time by Dr. Matthew and other Canadian geologists, second that they are *Silurian* as recently suggested by Dr. Matthew, third that they are *Carboniferous*, as suggested by Geinitz in 1866, and by many others since, principally Kidston, David White, Ami, and Zeiller. When I started upon my work, I had an entirely open mind upon the subject of the relative merits of these views. At the same time, I must confess to a natural hope that the stratigraphers were right, because in that case the flora would be of much greater interest, and would help to supply data which are greatly needed about pre-Carboniferous floras.

Dr. Ells, in his paper in the Canadian Record for 1901 (Ells, 1901), strenuously supports the stratigraphers and gives his opinion in favour of Sir W. Dawson's determination of the plant beds of the "Little River" group as Devonian. He concludes: "It is presumed that the present discussion will come to an end when those who now advocate the new theory as to the age of these rocks have made a careful study of their relations in the field"... "These difficult problems can be solved largely by careful field work, and instances are not wanting, even in the history of Canadian geological investigation, where apparently conflicting testimony between the rocks and their contained fossils has been readily harmonised so soon as the true stratigraphic relations were understood."

That this generalisation is true, no one who knows anything of the history of geology can deny. Indeed, on the face

of it, if Geology is a science at all, Stratigraphy and Palaeontology must prove ultimately to be harmonious.

The great difficulty in dealing with the stratigraphy of the beds now under consideration in the St. John area, is the lack of really good critical exposures. The Fern Ledges beds themselves are well exposed, but places where they come in contact with other beds are all too few, and the country is so wooded and otherwise covered that great jumps are taken from point to point, and (so it appeared to me) the stratigraphers have to see with the eye of faith what lies beneath the covered surfaces, and thereby have overlooked an important overthrust.

CONTRIBUTORY EVIDENCE.

The actual "Fern Ledges" are exceedingly poor in animal remains, though a few have been discovered in them. Their evidence is nullified by the stratigraphers, by means of a circular argument. As for instance when Dr. Matthew (1910, p. 120), says, speaking of Batrachian animals: "That animals of this comparatively high type of structure may have lived in Silurian times seems not improbable, when we consider that the vegetation of this time was so exceeding like that of the Carboniferous that paleophytologists of the highest renown have not hesitated to assert that the associated plants are Carboniferous." Thus by first asserting that the Carboniferous plants are Silurian, it is possible to argue when you find Carboniferous animals in the same beds, that they must be Silurian because the plants are! This method is used elsewhere (see pp. 130, Matthew, 1906). "It is an unexpected discovery to find such common species of the Coal Measures as *Calamites Cistii* and *Calamites Suckowi* flourishing in full perfection at this early time in geologic history, ...for if we have the identical plants of the Carboniferous time in these plant beds, why may we not have as well the land-snails, the insects, the myriapods and the amphibians of Carboniferous type." On the other hand Dr. Ami, who has done much work on these deposits, summarises the evidence as follows: (Ami, 1901, pp. 181 A) "To whatever horizon the Lancaster plants are assigned, the rocks of the Harrington River, Riversdale and Union, and possibly of the Horton formation must also be assigned".... "In so far as the faunas are concerned,

they clearly indicate a Carboniferous facies. These faunas include:—*Insecta*....referable to a well-known Carboniferous genus. *Phyllopoda*—the occurrence of typical examples of the genera *Leaia*, *Estheria* and related genera....all the world over recognised as Carboniferous, also points to the Carboniferous age of the rocks in Canada, from which the above forms were obtained. *Xiphosura*—....represented by three small but eminently characteristic specimens belonging to the genus *Prestwichia*—....usually referred to the Carboniferous system. *Podophthalmata*—represented by numerous examples of a genus allied to *Anthrapalaemon* of the Coal Measures....*Amphibia* —numerous tracks, footprints, etc.....all the species of *Sauropus* previously described from North America are placed in the Coal Measures...*Lamellibranchiata*—numerous examples....clearly referable to the genus *Anthracomya*....characteristic of distinct zones....in the Carboniferous."

Fish afford one of the best class of remains for stratigraphic purposes, and some were sent to Dr. Woodward to report on from this disputed terrain. Dr. Smith Woodward (1902) p. A 203, "From the shales of the Riversdale formation" in which a specimen of fossil fish was discovered "The genus is doubtful, but is almost certainly of a Carboniferous type." He continues— "From the shales of the Horton formation....the fossils.... are certainly Carboniferous but are not enough to determine whether Upper or Lower. The pieces of bone-bed exhibit scales of *Elonichthys*, species of *Acanthodes*, and one imperfect clavicle of a Rhizodont (probably *Strepsodus*.) The fine piece of jaw is a dentary of *Strepsodus hardingi*, Dawson sp." In conversation, Dr. Woodward tells me that it is impossible that beds containing these fish can be pre-Carboniferous.

The report of Dr. Ami's work continues: "It will thus be seen that Dr. David White's and Mr. Kidston's views on the fossil plants of the Riversdale formation and Horton series; and those of Dr. A. Smith Woodward upon the fossil fishes of the Horton, as well as his well known views on the age of the Albert shales of New Brunswick; also the views of Prof. T. Rupert Jones and Dr. Henry Woodward on the evidence afforded by the Ostracoda and Crustaceans; concur in placing these formations in the Carboniferous system."

CHAPTER IV.

BIBLIOGRAPHY.

NOTE.—Reference in the text is made as "Ami (1900)," for the first paper mentioned, "Ami (1900A)" for the second of the same year, and so on. The dates quoted are those on the title pages of the respective works.

AMI, H. M. (1900)—"On the Occurrence of a Species of Whittleseya in the Riversdale Formation (Eo-Carboniferous) of the Harrington River along the Boundary Line between Colchester and Cumberland Counties, Nova Scotia, Canada." Ottawa Naturalist, vol. 14, pp. 99-100. Ottawa, 1900.

——(1900A)—"Notes bearing on the Devono-Carboniferous Problem in Nova Scotia and New Brunswick. Ottawa Naturalist, vol. 14, pp. 121–127. Ottawa, 1900.

——(1900B)—"On the Sub-divisions of the Carboniferous System in Eastern Canada, with Special Reference to the Position of the Union and Riversdale Formations of Nova Scotia, referred to the Devonian System by some Canadian Geologists." Trans. Nova Scotian Inst. Sci., vol. 10, part 2, session 1899–1900, pp. 162–178. Halifax, 1900.

——(1901)—Work by Dr. Ami in Ann. Rep. Geol. Surv. Canada, vol. 11, for 1898, pp. 181A–182A. Ottawa, 1901.

——(1902)—Work by Dr. Ami in Ann. Rep. Geol. Surv., Canada, vol. 12, for 1899, pp. 199A–205A. Ottawa, 1902.

ANDRÄ, C. J. (1869)—"Vorweltliche Pflanzen aus dem Stein-Kohlengebirge der preussischen Rheinlande und Westphalens." 3rd part, pp. 35–50, pls. XI–XV. Bonn, 1869.

ANDREWS, E. B. (1875)—"Descriptions of Fossil Plants from the Coal Measures of Ohio." Rep. Geol. Surv. Ohio, vol. 2, Palaeontology, 2, pp. 413–426, pls. XLVI–LIII. Columbus, U.S.A., 1875.

ARBER, E. A. N. (1905)—"The Fossil Flora of the Culm Measures of North-West Devon, and the Palaeobotanical Evidence with Regard to the Age of the Beds." Phil. Trans. Roy. Soc. Lond., ser. B, vol. 197, pp. 291–325, pls. XIX–XX. London, 1905.

——(1905A)—"On some New Species of Lagenostoma, a Type of Pteridospermous Seed from the Coal Measures." Proc. Roy. Soc. B, vol. 76, pp. 245–259, pls. I–II, London, 1905.

ARTIS, E. T. (1825)—"Antediluvian Phytology, illustrated by a Collection of the Fossil Remains of Plants peculiar to the Coal Formations of Great Britain." (Ed. 2, 1838), pp. i–xiii, 1–24, pls. I–XXIV. London, 1825.

BAILEY, L. W. (1865)—"Observations on tne Geology of Southern New Brunswick, made principally during the summer of 1864 by Prof. L. W. Bailey, Messrs. Geo. F. Matthew, and C. F. Hartt." Printed by Order of House of Assembly; pp. 185 and Maps. Fredericton, 1865.

BOULAY, N. (1876)—"Le Terrain houiller du Nord de la France et ses végétaux fossiles." Thesis in Sci. Faculty, Caen, pp. 1–74, pls. I–IV. Lille, 1876.

BRONGNIART, A. (1822)—"Sur la Classification et la Distribution des Végétaux Fossiles en général, et sur ceux des terrains de sédiment supérieur en particulier." Mém. Mus. d'Hist. Nat., vol. 8, pp. 203–238, pls. XII–XV. Paris, 1822.

——(1828) [See note, p. 15]—"Histoire des Végétaux Fossiles, ou Recherches Botaniques et Géologiques sur les Végétaux renfermés dans les diverses Couches du Globe." Vol. I, pp. 488, pls. I–CLXVI. Paris, 1828–1837.

——(1828A)—"Prodrome d'une Histoire des Végétaux Fossiles." pp. 223, Paris, 1828; and Dict. Sci. Nat., vol. 57, pp. 16–212, Art. Végétaux Fossiles.

——(1837) [See note, p. 15]—"Histoire," etc., vol. 2, pp. 72 (?), pls. I–XXX. Paris, 1837–1838.

——(1881)—"Recherches sur les graines fossiles silicifiées, pp. 34, pls. I–XXI. Paris, 1881.

Corda, A. J. (1841)—"Zur Kunde der Karpolithen, namentlich jener der Steinkohlen formation." Verhandl. gess. Vaterl. Mus. Böhmen., pp. 95–109, pls. I–II. Prag, 1841.

Courron, O. (1909)—"A propos des couches à Psilophyton en Anjou." Bull. Soc. d'Études Sci. d'Angers, vol. 38, for 1908, pp. 83–95, fig. 22. Angers, 1909.

Crépin, F. (1874)—"Fragments paléonto'ogiques pour servir à la Flore du terrain houiller de Belgique." Bull. Acad. roy. Belg., 2nd ser., vol. 38, pp. 568–577, pls. I–II. Brussels, 1874.

——(1875)—"Observations sur quelques plantes fossiles des dépots dévoniens rapportés par Dumont à l'étage quartzoschisteux inférieur de son système eifelien." Bull. Soc. Roy. Bot. Belg., vol. 14, pp. 214–230, pls. I–VI. Brussels, 1875.

——(1879)—"Notes Paléophytologiques (Revision de quelques espèces figurées)." Bull. Soc. Roy. Bot. Belg., vol. 19, 2nd pt., pp. 22–29. Brussels, 1879.

——(1881)—See Mourlon, M., 1881.

Dawson, G. M. (1900)—"Summary Report on the Operations of the Geological Survey for the year 1899. Geol. Surv. Canada, pp. 1A–224A. Ottawa, 1900.

Dawson, J. W. (1855)—"Acadian Geology; An Accou. of the Geological Structure and Mineral Resources of Nova Scotia and Portions of the Neighbouring Provinces of British America"; pp. 388, map, and text figs. Edinburgh, 1855.

——(1859)—"On Fossil Plants from the Devonian Rocks of Canada." Quart. Journ. Geol. Soc., vol. 15, pp. 477–488. London, 1859.

——(1861)—"On the Pre-Carboniferous Flora of New Brunswick, Maine, and Eastern Canada." Canadian Naturalist, vol. 6, pp. 161–180, text figs. 1–12. Montreal, 1861.

——(1862)—"On the Flora of the Devonian Period in North-Eastern America." Quart. Journ. Geol. Soc., vol. 18, pp. 296–330, pls. XII–XVII. London, 1862.

——(1863)—"Further Observations on the Devonian Plants of Maine, Gaspé, and New York." Quart. Journ. Geol. Soc., vol. 19, pp. 458–469, pls. XVII–XIX. London, 1863.

——(1866)—"The Succession of Palaeozoic Floras of North America." Brit. Assoc. Rep., vol. 35, for Birmingham, 1865, pp. 50–51. London, 1866.

——(1868)—"Acadian Geology. The Geological Structure, Organic Remains, and Mineral Resources of Nova Scotia, New Brunswick, and Prince Edward Island." 2nd ed., pp. 694, map, and text figs. London, 1868.

——(1870)—"Bakerian Lecture. On the Pre-Carboniferous Floras of North-Eastern America, with special reference to the Erian (Devonian) Period." Abstract. Proc. Roy. Soc., vol. 18, pp. 333–335. London, 1870.

——(1871)—"The Fossil Land Plants of the Devonian and Upper Silurian Formations of Canada." Rep. Geol. Surv. Canada, pp. 1–92, pls. I–XX. Montreal, 1871.

——(1873)—"Fossil Plants of Lower Carboniferous and Millstone Grit Formation of Canada." Rep. Geol. Surv. Canada, pp. 1–47, pls. I–X. Montreal, 1873.

——(1878)—"Acadian Geology," etc. Ed. 3, with supplement; pp. 694, map, and text figs.; Suppl., pp. 1–102. London, 1878.

——(1881)—"Notes on New Erian (Devonian) Plants." Quart. Journ. Geol. Soc., vol. 37, pp. 299-308, pls. XII–XIII. London, 1881.

——(1882)—"The Fossil Plants of the Erian (Devonian) and Upper Silurian Formations of Canada." Pt. 2. Rep. Geol. Surv. Canada, pp. 95–142, pls. XXI–XXIV. Montreal, 1882.

——(1883)—"The Successive Palaeozoic Floras of Canada." Canadian Naturalist, vol. 10, pp. 371–378. Montreal, 1883.

——(1888) [See 1905].

——(1889)—"Ueker einige devonische Pflanzen." Zeits. deutsch. Geol. Gesell., vol. 41, pp. 553-554.

——(1890)—"New Plants from the Erian and Carboniferous, and on the Characters and Affinities of Palaeozoic Gymnosperms." Canad. Rec. Sci., vol. 4, No. 1, pp. 1–28, text figs. Montreal, 1890.

——(1891)—"The Geology of Nova Scotia, New Brunswick, and Prince Edward Island, or Acadian Geology." Ed. 4, with 2 suppl; pp. 694, and 1–102, and 1–37. London, 1891.

——(1905)—"The Geological History of Plants." Reprint of 1888 vol., which I have not seen; pp. 290, text figs. London, 1905.

Ells, R. W. (1885)—"Report on the Geological Formations of Eastern Albert and Westmoreland Counties, New Brunswick, and of portions of Cumberland and Colchester Counties, Nova Scotia, embracing the Spring Hill Coal Basin and the Carboniferous System North of Cobequid Mountains." Ann. Rep. Geol. and Nat. Hist. Surv. Canada, vol. 1, pt. E, dated 1884, pp. E1–E71. Montreal, 1885.

——(1901)—"The Devonian of the Acadian Provinces." Canad. Rec. Sci., vol. 8, No. 6, pp. 335–343. Montreal, 1901.

——(1906)—"Southern New Brunswick." Summary Rep. Geol. Surv. for year 1906, sess. paper 26, pp. 131-139. Ottawa, 1906.

——(1908)—"Surveys in Southern New Brunswick." Summary Rep. Dept. Mines, Geol. Surv. Canada for year 1907, sess. paper 26, pp. 74–76. Ottawa, 1908.

Ettingshausen, C. von (1852)—"Die Steinkohlenflora von Stradonitz in Böhmen." Anhandl. K. K. Geol. Reichsanst, vol. 1, Abt. 3, pp. 1–18, pls. I–VI. Vienna, 1852.

Fiedler, H. (1857)—"Die Fossilen Früchte der Steinkohlenformation." Nov. Art. Acad. Caes. Leop.-Carol. Nat. Cur., vol. 26, pp. 241–296, pls. XXI–XXVIII. Halle, 1857.

Fletcher, H. (1900)—"Geological Nomenclature in Nova Scotia." Trans. Nova Scotia Inst. Sci., vol. 10, pt. 2, pp. 235–244. Halifax, 1900.

Geinitz, H. B. (1855)—"Die Versteinerungen der Steinkohlenformation in Sachsen"; pp. i–vi, 1–61, pls. I–XXXVI. Leipzig, 1855.

——(1866)—"Report of Meeting. Remark on Scudders insects from Canada. Sitzungsber. naturwiss. Gesell. Isis. Jahrg. 1866, No. 1–3, p. 22. Dresden, 1866.

GERMAR, E. F. (1844–1853)—"Die Versteinerungen des Steinkohlengebirges von Wettin und Löbejün in Saalkreise." 8 hefts, pp. 116, pls. I–XL. Halle, 1844–1853.

GOEPPERT, H. R. (1836)—"Die Fossilen Farrnkräuter." Nov. Act. Acad. Caes. Leop.-Carol. Nat. curios. suppl., vol. 17, pp. 1–486, pls. I–XLIV. Breslau and Bonn, 1836.
——(1841)—"Die Gattungen der fossilen Pflanzen." Lief 1–2, pp. 30, 36, pls. XVIII. Bonn, 1841.

GRAND 'EURY, F. C. (1877)—"Mémoire sur la Flore Carbonifère du Département de la Loire et du Centre de la France, étudiée aux trois points de vue botanique, stratigraphique et géognostique." Mém. Acad. Sci. Inst. Nation. France, vol. 24, No. 1, pp. 1–624, pls. I–XXXIV, A–C. Paris, 1877.
——(1890)—"Géologie et Paléontologie du Bassin Houiller du Gard;" pp. 354, pls. I–XXII (double size). St. Etienne, 1890.

GUTBIER, O. L. VON (1837)—"Pflanzenabdrucke des Rothliegenden und der Kohlenformation der gegend von Zwirksur." Isis, pp. 435–436. Leipzig, 1837.

HAGEN, H. A. (1881)—"The Devonian Insects of New Brunswick, with Additional Remarks upon a Fern in the same slab with Plateparmera." Bull. Harvard Mus. Compar. Zoöl., March, 1881, No. 14, vol. 8, pp. 275–284. Cambridge, U.S.A., 1881.

HARTT, C. F. (1865)—"On the Devonian Plant Locality of the "Fern Ledges," Lancaster, New Brunswick." Appendix A in L. W. BAILEY'S (1865) Report, pp. 131–141. Fredericton, 1865.

HOFMAN, A., and RYBA, F. (1899)—"Leitpflanzen der palaeozoischen Steinkohlenablagerungen in Mittel-Europa." Pp. 104, pls. I–XX. Prag, 1899.

JONGMANS, W. J. (1911)—"Anleitung zur Bestimmung der Karbonpflanzen West-Europas mit besonderer Berück sichtigung der in den Niederlanden und den benachbarten Ländern gefundenen oder noch zu erwartenden Arten. Vol. I. Thallophytae, Equisetales, Sphenophyllales." Med. Rijksopsporing van Delfstoffen, No. 3, pp. 482, text figs. Gravenhage, 1911.

KIDSTON, R. (1886)—"Catalogue of the Palaeozoic Plants in the Department of Geology and Palaeontology, British Museum (Natural History), pp. 228. London, 1886.

——(1889)—"On some Fossil Plants from Teilia Quarry, Gwaenysgor, near Prestatyn, Flintshire." Trans. Roy. Soc. Edin., vol. 35, pt. 2, No. 11, pp. 419–428, pls. I–II. Edinburgh, 1889.

——(1894)—"On the Various Divisions of British Carboniferous Rocks as determined by their Fossil Flora." Vice-Presidential address, and notes on New Species. Proc. Roy. Physical Soc. Edinburgh, sess. 123, pp. 183–268, pls. IV–VI. Edinburgh, 1894.

——(1897)—"On the Fossil Flora of the Yorkshire Coal-fields I." Trans. Roy. Soc. Edinburgh, vol. 38, pp. 203–223, pls. I–III. Edinburgh, 1897.

——(1899)—Report on Fossil Plants. MS. quoted by Whiteaves. See WHITEAVES (1899), p. 216.

——(1904) "On the Fructification of *Neuropteris heterophylla*, Brongniart." Phil. Trans. Roy. Soc. Lond., ser. B, vol. 197, pp. 1–5, pl. I. London, 1904.

——(1905)—"On the Divisions and Correlation of the Upper Portion of the Coal Measures, with special reference to their Development in the Midland Counties of England." Quart. Journ. Geol. Soc. Lond., vol. 61, pp. 308–323. London, 1905.

——(1911)—"Les Végétaux houillers recueillis dans le Hainaut Belge et se trouvant dans les collections du Musée Royal d'Histoire Naturelle à Bruxelles." Extr. Mém. Mus. Roy. d'Hist. Nat. Belg. t. 4, year 1909, pp. 1–282, pls. I–XXIV. Brussels, 1911.

LESQUEREUX, L. (1879–1884)—"Description of the Coal Flora of the Carboniferous Formation in Pennsylvania and throughout the United States." Rep. Progr., 2nd Geol. Surv. Penn., vols. 1 and 2, pp. i–lxiii, 1–694, Harrisburg, 1880. Atlas, pls. I–LXXXV, Harrisburg, 1879. Vol. 3, pp. 695–977 and pls. LXXVIII–CXI. Harrisburg, 1884.

MATTHEW, G. F. (1863)—"Observations on the Geology of St. John County, New Brunswick." Canad. Naturalist and Geologist, vol. 8, pp. 241–260. Montreal, 1863.

——(1901)—"Are the St. John Plant Beds Carboniferous?" [illegible]ondence, Amer. Journ., June 1901, vol. 27, [illegible]3–386. Minneapolis, 1901.

— -(1901A)—"A Backward Step in Palaeobotany." Trans. Roy. Soc. Canada, ser. 2, vol. 7, pp. 113–122. Ottawa, 1901.

——(1906)—"A Review of the Flora of the Little River Group." Trans. Roy. Soc. Canada, vol. 12, sect. 4, pp. [illegible]–133, pls. I–VIII. Ottawa, 1906.

——(1906A)—"New Species and a New Genus of Devonian Plants" [corrected in writing to Silurian]. Bull. Nat. Hist. Soc. New Brunswick, vol. 5, No. 24, pp. 393–398. St. John, N.B., 1906.

——(1908)—"On some New Species of Silurian and Devonian Plants." Trans. Roy. Soc. Canada, ser. 3, vol. 1, sect. 4, pp. 185–197, 3 figs. on pl. Ottawa, 1908.

——(1910)—"The Oldest Silurian Flora." Bull. Nat. Hist. Soc. New Brunswick, No. 28, vol. 6, pp. 241–250. St. John, N.B., 1910.

——(1910A)—"Revision of the Flora of the Little River Group No. II." Trans. Roy. Soc. Canada, ser. 3, vol. 3, pp. 77–102, pls. I–VI. Ottawa, 1910.

——(1910B)—"Remarkable Forms of the Little River Group." Trans. Roy. Soc. Canada, ser. 3, vol. 3, pp. 115–125, pls. I–IV. Ottawa, 1910.

——(1910C)—"The Geologic Age of the Little River Group." Trans. Roy. Soc. Canada, ser. 3, vol. 3, pp. 67–75. Ottawa, 1910.

——(1911)—"Review of the Flora of the Little River Group No. III." Trans. Roy. Soc. Canada, ser. 3, vol. 4, pp. 3–21, pl. Ottawa, 1911.

——(1912)—"Were there Climatic Zones in Devonian Time?" Trans. Roy. Soc. Canada, ser. 3, vol. 5, pp. 125–153. Ottawa, 1912.

Morton, G. H., and Strahan, A. (1888)—"Carboniferous, Devonian, and Old Red Sandstone, Report of Sub-Committee, No. IV." Compt. Rendu. Congrès Géol. Internat., 4th sess. London, 1888. Appendix B (issued 1891), pp. B137–B159. Cambridge, 1888.

Mourlon, M. (1881)—"Geologie de la Belgique." Vols. 1 and 2, pp. 317 and 392. Brussels, 1881.

Nathorst, A. G. (1894)—"Zur Paläozoischen Flora der Arktischen zone enthaltend die auf Spitsbergen, auf der Bären-Insel und auf Novaja Zemlja von den Schwedischen Expeditionen Entdeckten Paläozischen Pflanzen." K. Svensk. Vetensk.-Akad. Handl., vol. 26, No. 4, pp. 1–80, pls. I–XVI. Stockholm, 1894.

——(1908)—"Paläobotanische Mittheilungen 4–6." K. Svensk. Vetens. Akad. Handl., vol. 43, No. 6, pp. 3–32, pls. I–IV. Stockholm, 1908.

Newberry, J. S. (1873)—"Descriptions of Fossil Plants from the Coal Measures of Ohio." Rep. Geol. Surv. Ohio, vol. 1, pt. 2, pp. 359–385, pls. XLI–XLVIII. Columbus, U.S.A., 1873.

Oliver, F. W., and Scott, D. H.—"On the Structure of the Palaeozoic Seed Lagenostoma Lomaxi, with a Statement of the Evidence upon which it is referred to Lyginodendron." Phil. Trans. Roy. Soc. Lond., ser. B, vol. 197, pp. 193–247, pls. IV–X. London, 1904.

Potonié, H. (1893)—"Ueber einige Carbon-farne IV Theil." Jahrb. K. Preuss. Geol. Landesanst. Bergakad. for 1892, vol. 13, pp. 1–11, pls. I–III. Berlin, 1893.

——(1893A)—"Die Flora der Rothliegenden von Thuringen." Abhandl. K. Preuss. Geol. Landesanst. heft 9, pp. 1–298, pls. I–XXXIV. Berlin, 1893.

——(1899)—"Lehrbuch der Pflanzenpalaeontologie mit besonderer Rücksicht auf die Bedürfnisse des Geologen." Pp. 402, 3 pls. and 355 text figs. Berlin, 1897–1899.

——(1903)–(1910)—"Abbildungen und Beschreibungen fossiler Pflanzen—Reste der palaeozoischen und mesozoischen Formationen." Berlin, 1903-1910, incomplete.

Lief. 1, Nos. 1-20, 1903.
Lief. 2, Nos. 21-40, 1904.
Lief. 3, Nos. 41-60, 1905.
Lief. 4, Nos. 61-80, 1906.
Lief. 5, Nos. 81-100 and Index, 1907.
Lief. 6. Nos. 101-120, 1909.
Lief. 7, Nos. 121-140, 1910.

RATHBUN, R. (1878)—"Sketch of the Life and Scientific Work of Professor Charles Frederic Hartt." Proc. Boston Soc. Nat. Hist., vol. 19, from 1876–1878. pp. 338–364. Boston, 1878.

RENAULT, B. (1883)—"Cours de Botanique Fossile fait au Muséum d'Histoire Naturelle, Fougères, 3rd ann."; pp. 241, pls. I–XXX[illegible]nd A. Paris, 1883.

——(1885)—"Cours," et[illegible]ifères—Gnetacées, 4th ann."; pp. 232, pls. I–XXII an[illegible]D. Paris, 1885.

——(1890)—"Flore fossile terrain houiller de Commentry." 2nd pt., pp. 381-712, pls. XLIII-LXXV. St. Étienne, 1890.

RENIER, A. (1910)—"Documents pour l'étude de la Paléontologie du terrain houiller," pp. 26, pls. I.-CXVIII., Liège, 1910.

ROGERS, H. D. (1858)—"The geology of Pennsylvania, a Government Survey with a general view of the Geology of the United States, Essays on the coal formation and its fossils and a description of the coal fields of North America and Great Britain." Vol. 2, pp. 667-1045, pls. I-XXIII. Edinburgh, 1858.

SAUVEUR (1848)—"Végétaux fossiles des terrains houillers de la Belgique." Acad. Roy. Soc. Belg., pls. I-LXIX, pages ? (Have only seen separate copy without reference to volume).

SCHIMPER, W. P. (1862)—"Les Végétaux fossiles du Terrain de Transition des Vosges," in Koechlin-Schlumberger and Schimper "Le Terrain de Transition des Vosges," pp. 309-343, pls. I-XXX. Strasbourg, 1862.

—— (1869) — "Traité de Paléontologie Végétale ou la Flore du Monde Primitif dans ses Rapports avec les Formations géologiques et la Flore du monde actuel." Vol. 1, pp. 738, and Atlas, pls. I–CX. Paris, 1869.

——(1872)—"Traité," etc. Vol. 2, pp. 968. Paris, 1870-1872.

——(1874)—"Traité," etc. Vol. 3, pp. 896. Paris, 1874.

SCHLOTHEIM, E. F. (1804)—"Beiträge zur Flora der Vorwelt, Beschreibung merkwündiger Kräuter-Abdrücke und Pflanzen-Versteinerungen," pp. 68, pls. I–XIV. Gotha, 1804.

——(1820)—"Die Petrefactenkunde auf ihrem jetzigen Standpunkte durch die Beschreibung seiner Sammlung versteinerter und fossiler überreste des Thier—und Pflanzenreichs der Vorwelt erläutert." Pp. 437, pls. XV. Gotha, 1820.

SCOTT, D. H. (1906)—"On *Sutcliffia insignis*, a new Type of Medulloseae from the Lower Coal Measures." Trans. Linn. Soc. Lond., vol. 7, pt. 4, pp. 45-68, pls. London, 1906.

——(1908) — "Studies in Fossil Botany," Ed. 2, vol. 1, pp. 363, text figs. London, 1908.

——(1909)—"Studies,"etc., vol. 2, pp. 355-676, text figs. London, 1909.

SCOTT, D. H., and MASLEN, A. J. (1907)—"The Structure of the Palaeozoic Seeds, Trigonocarpus Parkinsoni, Brongniarti and Trigonocarpus Oliveri, sp. nov., Part I." Ann. Bot. vol. 21, pp. 89-132, pls. XI–XIV. London, 1907.

SELLARDS, E. H. (1908)—"Fossil Plants of the Upper Palaeozoic of Kansas." Univ. Geol. Surv. Kansas, vol. 9, ch. X, pp. 386-480, pls. XLIV–LXIX. Topeka, U.S.A. 1908.

SEWARD, A. C. (1898) (1910)—"Fossil Plants; a text book for students of Botany and Geology." Vols. 1 and 2, pp. 452 and 624, text illust. Cambridge, 1898 and 1910.

SEWARD, A.C., and LESLIE, T. N. (1908)—"Permo-Carboniferous Plants from Vereeniging (Transvaal)." Quart. Journ. Geol. Soc, vol. 64, pp. 109-126, pls. IX–X. London, 1908.

SOLMS LAUBACH, H. GRAF. ZU. (1891)—Fossil Botany, being an introduction to Palaeophytology from the standpoint of the botanist." Engl. transl., pp. 401, text figs. Oxford, 1891.

SMITH, G. O., and WHITE, D. (1905)—"The Geology of the Perry Basin in Southeastern Maine." Profess. Paper, No, 35, U.S. Geol. Surv., pp. 1-92, pls. I-VI. Washington, 1905.

STERNBERG, K. (1820-1838)—"Versuch einer geognostisch botanischer Darstellung der Flora der Vorwelt." 8 fascicles, pls. I-LXVIII. and A-E. Léipzig, 1820-1838.

STOPES, M. C. (1906)—"A new Fern from the Coal Measures, *Tubicaulis Sutcliffii*, sp. nov." Mem. and Proc. Manch. Lit. and Phil. Soc. vol. 50, pp. 1-32, pls. Manchester, 1906.

STOPES, M. C., and WATSON, D. M. S. (1908)—"On the Present Distribution and Origin of the Calcareous Concretions in Coal Seams, known as 'Coal Balls.'" Phil. Trans. Roy. Soc. Lond., B, vol. 200, pp. 167–218, pls. XVII–XIX. London, 1908.

STUR, D. (1875)—"Die Culm-Flora des Mährisch-Schlesischen Dachschiefers." Abhandl. K. K. Geol. Reichsanst., vol. 8, heft. 1, pp. 1–106, pls. I- XVII. Vienna, 1875.

——(1877)—"Die Culm-Flora, II, Die Culm-Flora der Ostrauer und Waldenburger Schichten." Abhandl. K. K. Geol. Reichsanst., vol. 8, pp. i–xiv, 1–366, pls. I (XVIII)–XXVII (XLIV). Vienna, 1877.

– —(1885)—"Die Carbon-Flora der Schatzlarer Schichten." Abhandl. K. K. Geol. Reichsanst, vol. 11, pp. 1–418, pls. XVIII–XXV, XXVb, XXVI–LXV. Vienna, 1885.

SUCKOW, G. A. (1784)—"Beschreibung einiger merkwürdig Abdrücke von der Art der sogennanten Calamiten Hist. et comment. Acad. elect. Theodoro-Palatina vol. 5. Mannheim, 1784. [Quoted reference. I ha not seen this].

UNGER, F. (1850)—"Genera et species plantarum fossilium pp. 627. Vindobonae, 1850.

WHITE, D. (1895)—"The Pottsville Series along New Rive West Virginia." Bull. Geol. Soc. Amer., vol. 6, p 305–320. Rochester, U.S.A., 1895.

——(1899)—"Fossil Flora of the Lower Coal Measures Missouri." Mon. U.S. Geol. Surv., vol. 37, pp. 1–30 pls. I–LXXIII. Washington, 1899.

——(1900)—"The Stratigraphic Succession of the Fossil Flor of the Pottsville Formation in the Southern Anthraci Coal Field, Pennsylvania." 20th Ann. Rep. U.S. Geo Surv. for 1898–1899, pt. 2, pp. 749–918, pls. CLXXX CXCIII. Washington, 1900.

——(1901)—"The Canadian Species of the Genus Whittlesey and their Systematic Relations." Ottawa Naturalis vol. 15, No. 2, pp. 98–110, pl. VII. Ottawa, 1901.

——(1901A)—"Some Palaeobotanical Aspects of the Upp Palaeozoic in Nova Scotia." Canad. Rec. Sci., vol. pp. 271–280. Montreal, 1901.

——(1902) — "Stratigraphy versus Palaeontology in Nov Scotia." Science, new ser., vol. 16, pp. 232–235. Ne York, 1902.

——(1908)—"Flora Fossil das Coal Measures do Brazil (Foss Flora of the Coal Measures of Brazil)." In J. C. Whit Rel. Final Commiss. de estudos das minas de Carvao d Pedra de Brazil, pp. 337–617, pls. V–XIV. Rio d Janeiro, 1908.

——(1911)—Discussion and Correspondence, "A Carboniferou Flora in the Silurian.?" Science, vol. 34, No. 875, pp 440–442. New York, 1911.

WHITEAVES, J. F. (1899)—"The Devonian System in Canada." Address of Vice-Pres. Sect. E, Amer. Assoc. Sci. Columbus, Ohio, 1899. Amer. Geol., vol. 24, pp. 210–240. Minneapolis, 1899.

WILSON, W. J. (1910)—"Palaeontological Material from the Devonian and Carboniferous of Southern New Brunswick." Summary Rep. Geol. Surv. Canada for 1909, pp. 274–276. Ottawa, 1910.

WOOD, H. (1860)—"Contributions to the Carboniferous Flora of the United States." Proc. Acad. Nat. Sci. Philadel., pp. 236–240. Philadelphia, 1860.

WOODWARD A. SMITH (1902)—"Report on Fish Remains," in the Rep. Geol. Surv. for 1899, vol. 12, p. A.203. Ottawa, 1902.

ZEILLER, R. (1878)—"Sur une nouvelle espèce de Dicranophyllum." Bull. Soc. Géol., 3rd ser., vol. 6, for 1877–1878, pp. 611–615, pl. X. Paris, 1878.

——(1880)—"Végétaux fossiles du terrain houiller de la France." Extr., vol. 4, Explic. Carte géol. France, pp. 1–185, pls. CLIX–CLXXVI. Paris, 1880.

——(1883)—"Fructifications de Fougères du terrain houiller." Ann. Sci. Nat., ser. 6, Bot. vol. 16, pp. 177–209, pls. IX–XII. Paris, 1883.

——(1886–1888)—"Bassin Houiller de Valenciennes. Description de la Flore Fossile." Texte, pp. 731, 1888, plates in Atlas, I–XCIV. 1886.

——(1892)—"Études sur la flore fossile des dépôts houillers et permiens des environs de Brive," pp. 132, pls. I–XV. Paris, 1892.

——(1895)—"Sur les Subdivisions du Westphalien du Nord de la France d'après les charactères de la flore." Bull. Soc. Géol. France, ser. 3, vol. 22, pp. 483–501. Paris, 1895.

——(1900)—"Éléments de Paléobotanique," pp. 417, text figs. Paris, 1900.

——(1903)—"Etudes des Gîtes minéraux de la France. F
fossile des Gîtes de charbon du Tonkin." Serv. C
Géol. det., pp. 1–328, pls. A–F. Atlas pls. I–L
Paris, 1902–1903.

——(1908)—"Revue des travaux de paléontologie végétale
années 1901–1906." Rev. Gén. Bot., vol. 20, pp. in se
from p. 40. Paris, 1908.

ZENKER (1833)—"Beschreibung von Galium sphenophyllo
Zenk." Neues Jahrb. Min. Geogn. Geol. Petrefa
pp. 398–400, pl. V, figs. 6–9. Stuttgart, 1833.

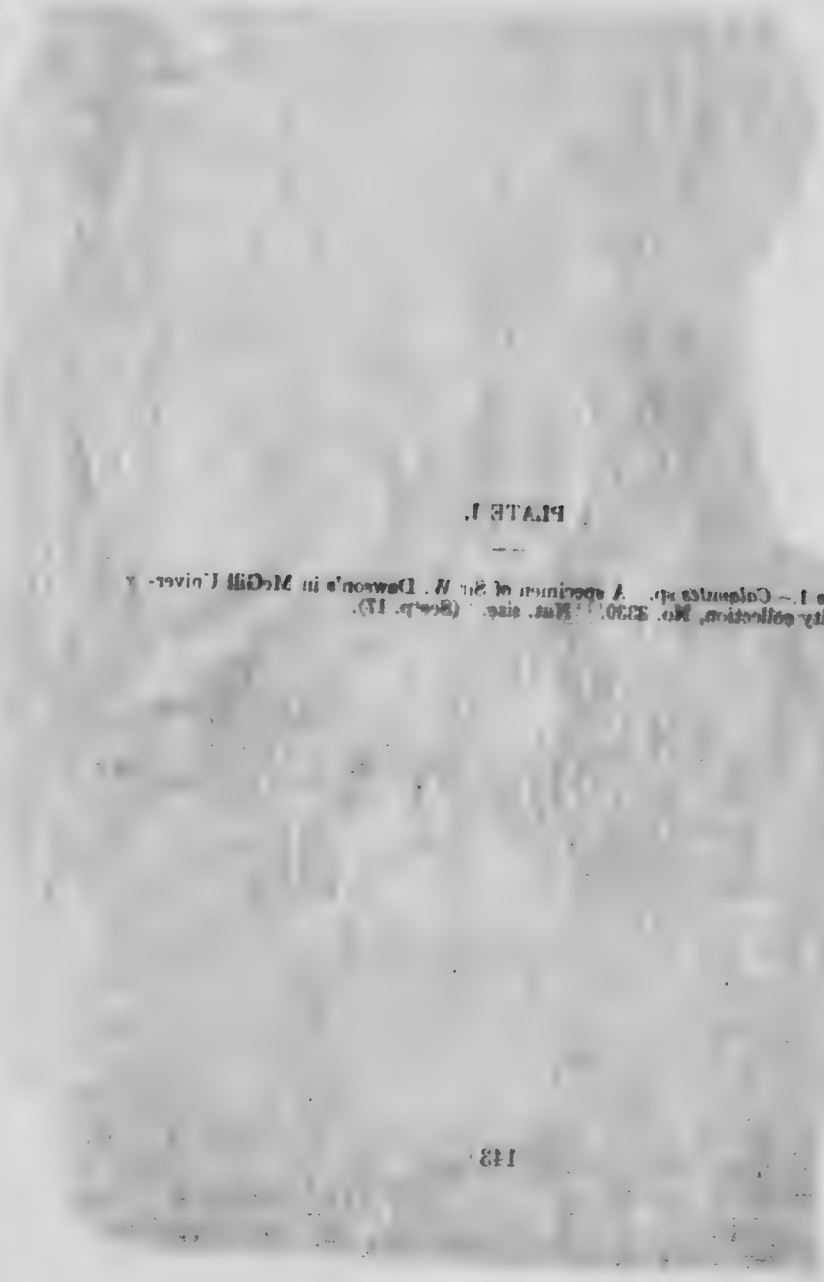

Figure 1.—Calamites sp. A specimen of Sir *W.* Dawson's in McGill University collection, No. 3330. Nat. size. (Scott p. 17).

PLATE I

Figure 1.— *Calamites* sp. A specimen of Sir W. Dawson's in McGill University collection, No. 3339. Nat. size. (See p. 17).

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PLATE II

Figure 2.—Calamites Suckowi. Brongniart. Original of Dawson's 1871 fig. 47, pl. IV, McGill University collection, No. 3956. Mat. arg. (See p. 14).

PLATE II.

Figure 2.—*Calamites Suckowi*, Brongniart. Original of Dawson's
fig. 47, pl. IV, McGill University collection, No. 3336. Nat.
(See p. 15).

awson's 1871,
M. Nat. size.

Figure 3.—*Calamites* sp. A specimen of Sir W. Dawson's in McGill University collection, No. 3335. Similar to the one he figured in 1871, pl. IV, fig. 11. Nat. size. (See p. 17).

Figure 4.—*Calamostachys* sp. Nat. Hist. Mus., St. John. Nat. size. (See p. 18).

PLATE III.

Figure 3.—*Calamites* sp. A specimen of Sir W. Dawson's in McGill University collection, No. 3335. Similar to the one he figured in 1871, pl. IV, fig. 41. Nat. size. (See p. 17).

Figure 4.—*Calamostachys* sp. Nat. Hist. Mus., St. John. Nat. size. (See p. 18).

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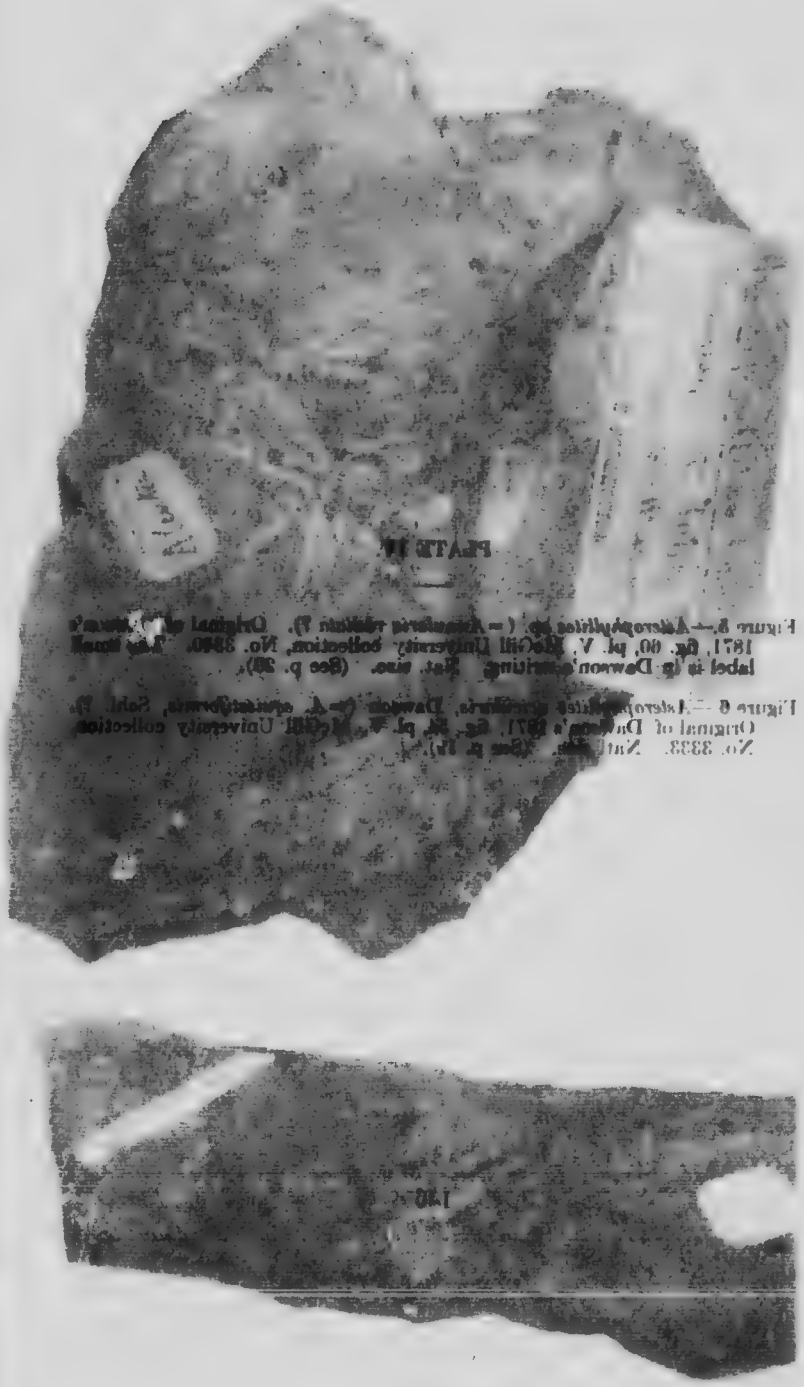

PLATE IV.

Figure 5.—*Asterophyllites* sp. (=*Annularia radiata* ?). Original of Da
1871, fig. 60, pl. V, McGill University collection, No. 3340. The
label is in Dawson's writing. Nat. size. (See p. 20).

Figure 6.—*Asterophyllites acicularis*, Dawson (=*A. equisetiformis*, Sc
Original of Dawson's 1871, fig. 54, pl. V, McGill University coll
No. 3333. Nat. size. (See p. 19).

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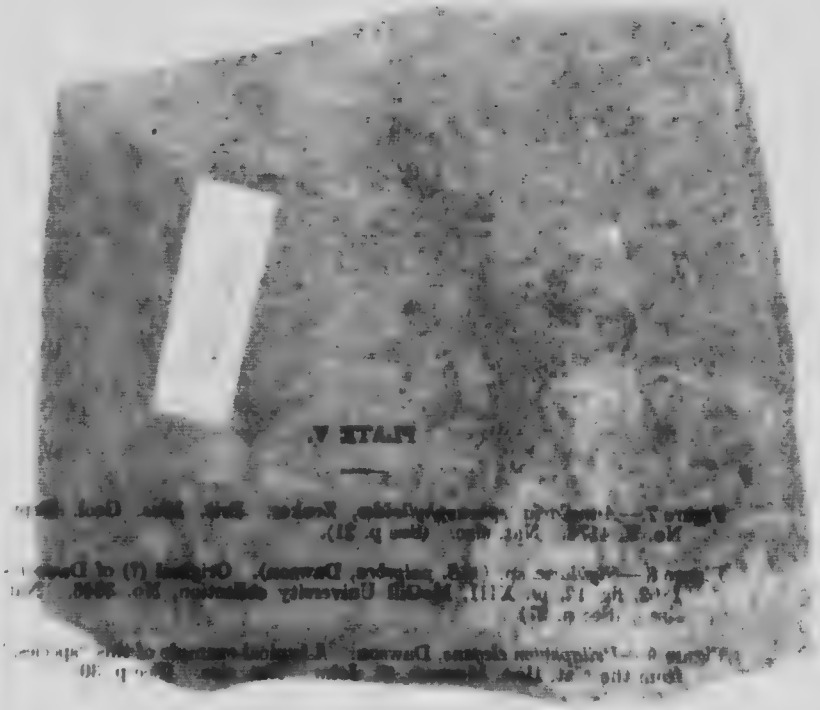

PLATE V.

Figure 7.—*Annularia sphenophylloides*, Zenker. Brit. Mus. No. V. 4174. Nat. size. (See p. 21).

Figure 8.—*Sigillaria* sp. (=*S. palpebra*, Dawson). Original (?) 1862, fig. 12, pl. XIII, McGill University collection, No. size. (See p. 27).

Figure 9.—*Psilophyton elegans*, Dawson. A typical example of t from the Nat. Hist. Museum, St. John. Nat. size. (See

it. Mus. Geol. Dept.,

Original (?) of Dawson's
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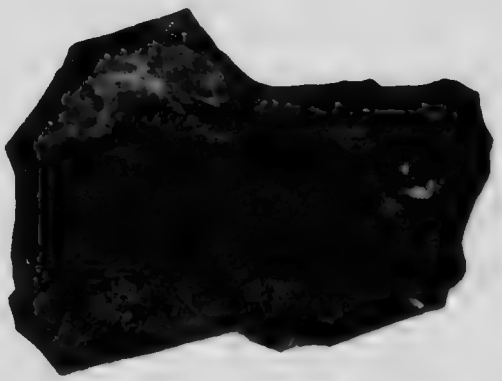

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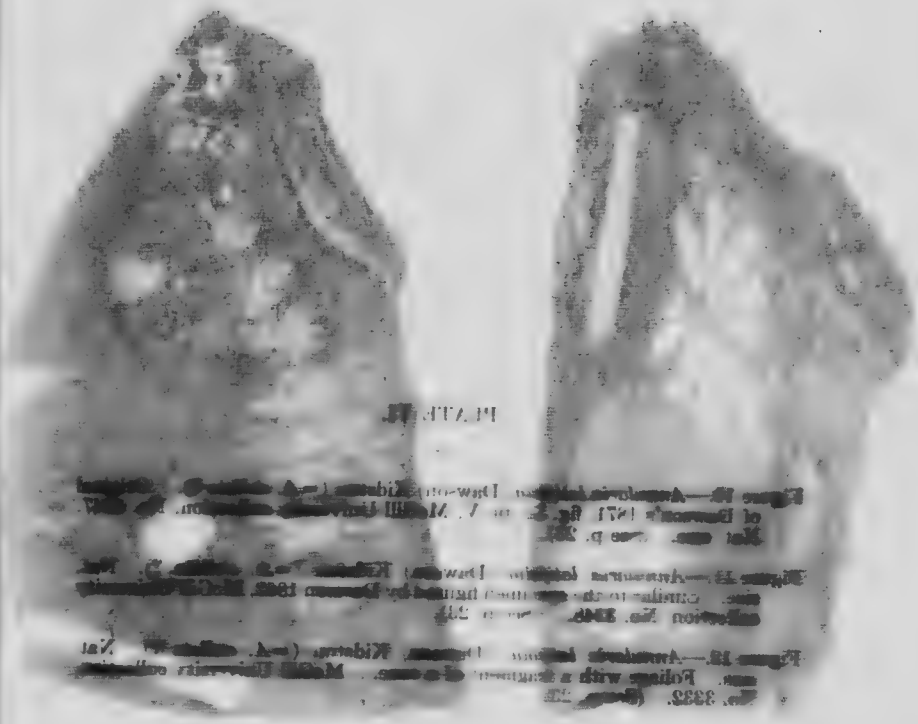

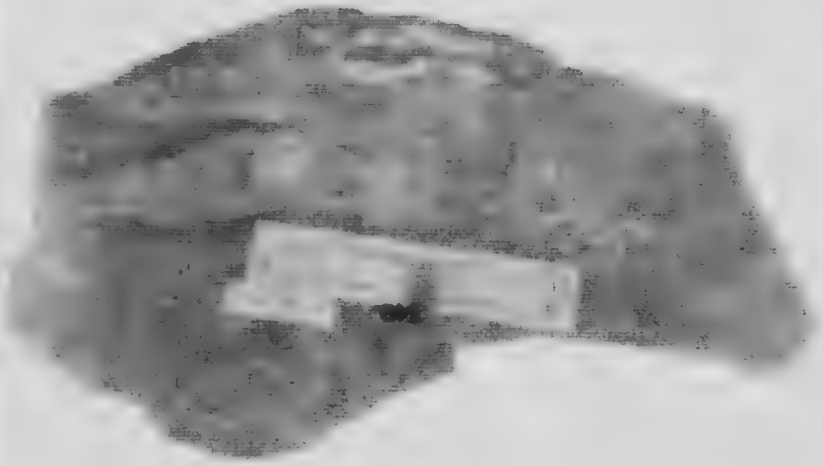

PLATE VI.

Figure 10.—*Annularia latifolia* (Dawson) Kidston (=*A. stellata* ?). of Dawson's 1871, fig. 51, pl. V. McGill University collection, Nat. size. (See p. 23)

Figure 11.—*Annularia latifolia* (Dawson) Kidston (=*A. stellata* size. Similar to the specimen figured by Dawson 1862, McGill U collection, No. 3348. (See p. 23).

Figure 12.—*Annularia latifolia* (Dawson) Kidston (=*A. stellata* size. Foliage with a fragment of a cone. McGill University No. 3332. (See p. 23).

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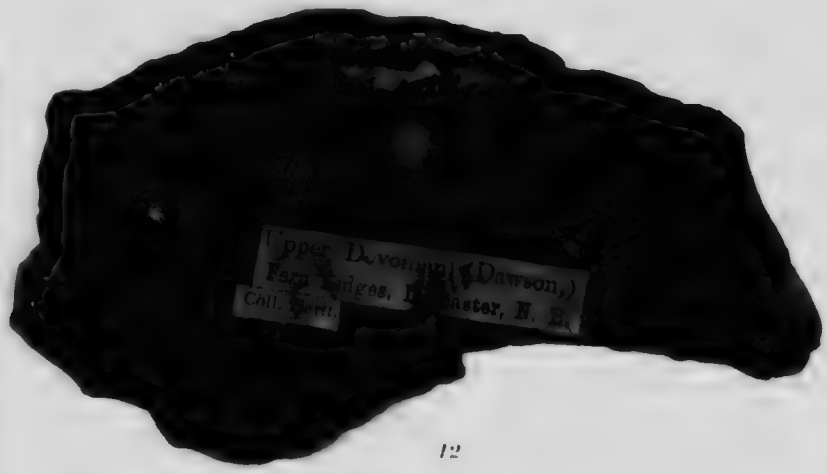

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stellata ?). Original collection, No. 3347.

stellata ?). Nat. 2, McGill University

stellata ?). Nat. niversity collection,

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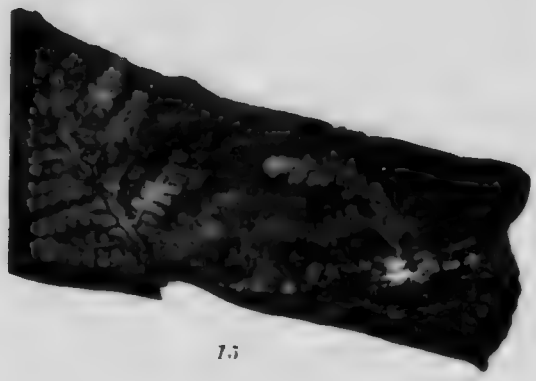

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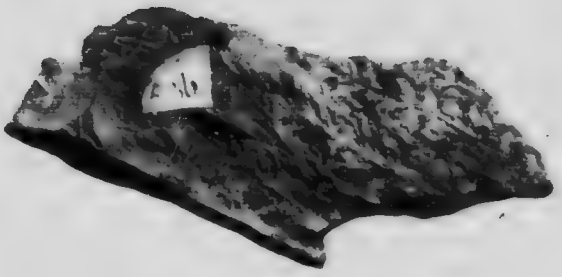

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Dawson's 1871 pl.
rifolia, Dn., McGill
ules marked X are

wson's 1871 fig. 196,
ype 2," now in Brit.

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Figure 20.—Sphenopteris marginata, Dawson (= S. rotundifolia, Artis). Larger specimen showing pinnae attached to rachis. Nat. size. (See Dept. V 1057. Nat. size. (See p. 32

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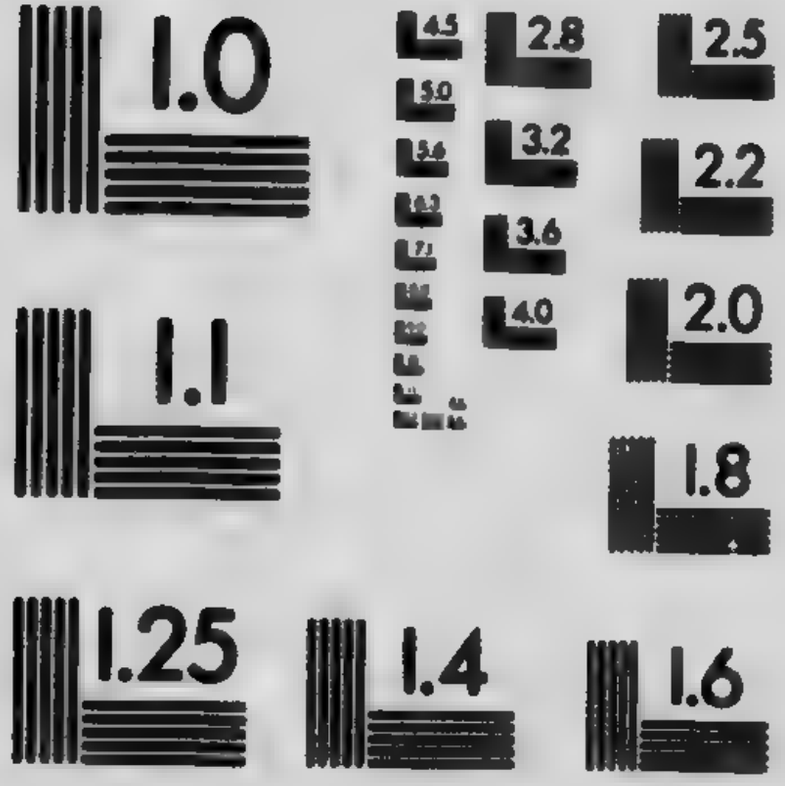

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Figure 19.—*Sphenopteris marginata*, Dawson (=*S. rotundifolia*, A second specimen included, McGill University collection, No. phot. 18). Nat. size. (See p. 32).

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undifolia, Andrä). University collec-

undifolia, Andrä). tion, No. 3317 (see

lifolia, Andrä). A Brit. Mus. Geol.

PLATE IX

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S. artemisiaefolioides, *Neuropteris*, etc. Also 911, Duck Cove. Nat.

PLATE X.

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1871, fig. 180, pl. XVI, McGill University collection. No. D.
(See p. 37).

iriaefolioides, Crépin).
Gill University collec-

iriaefolioides, Crépin).
nnules. Collected by
).

Brongniarti, Stur).
Gill University collec-

Original of Dawson's
on. No. D. Nat. size.

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PLATE XI.

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Wilson, Canadian Geol. Surv. collection. Showing rachis and
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side pinnules towards the axis. Nat. size. (See p. 37).

ollected by Mr.
rachis and foliage
rrangement of the
').

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ens given to McGill
errulata, Hartt. No.
(See p. 44).

f Dawson's specimens
No. 3312. Nat. size.

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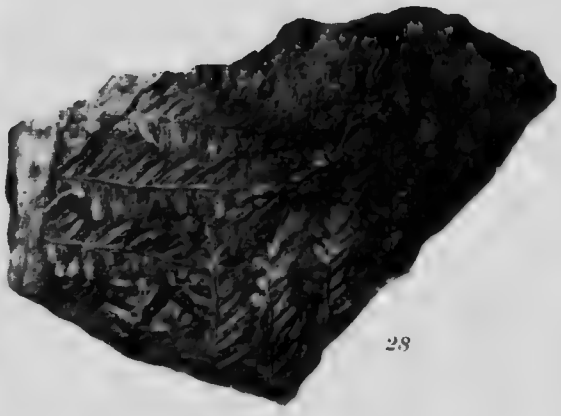

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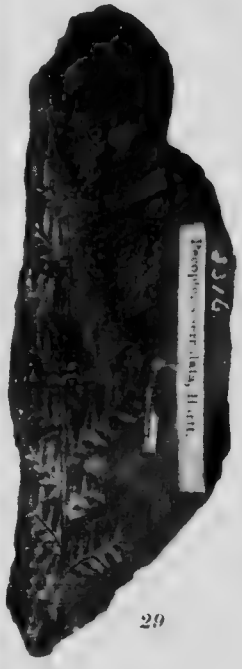

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Original of Dawson's collection, No. 3314.

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Alethopteris lonchitica, easures section. Col-

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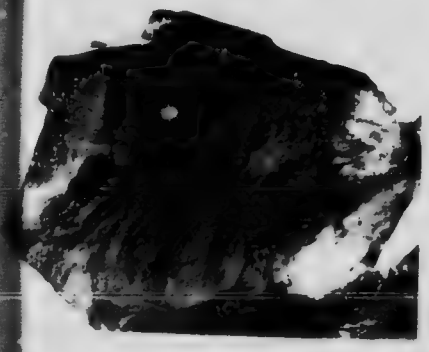
Dawson's specimens, ows the branching of



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ymorpha, Dawson).
McGill University

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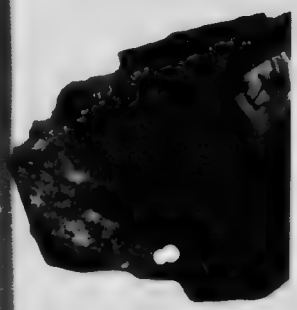

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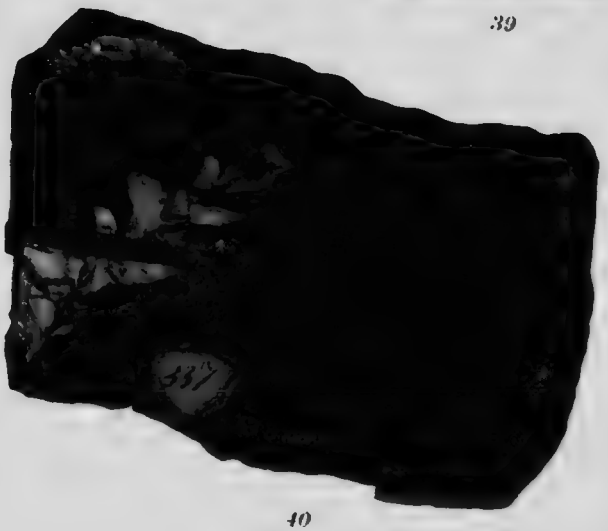

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Figure 41.—*Neuropteris gigantea*, Sternberg (=*N. retorquata*, D
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Nat. size. (See p. 56).

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rquata, Dawson).
. McGill Univer-

Dawson). Original
llection, No. 3323.

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Dr. Matthew's
cIntosh, curator
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's 1871 fig. 202,
Nat. size. (See

ctification, show-
Brit. Mus. Geol.

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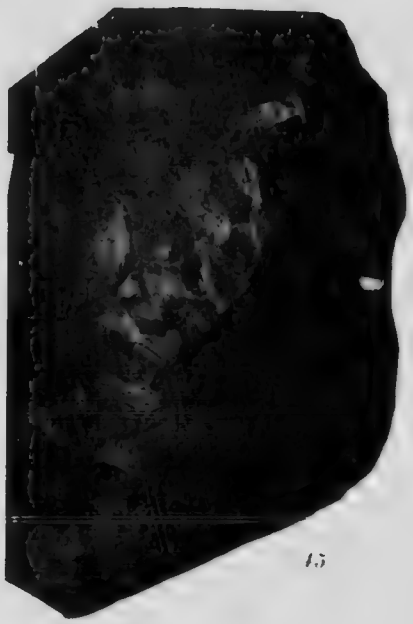

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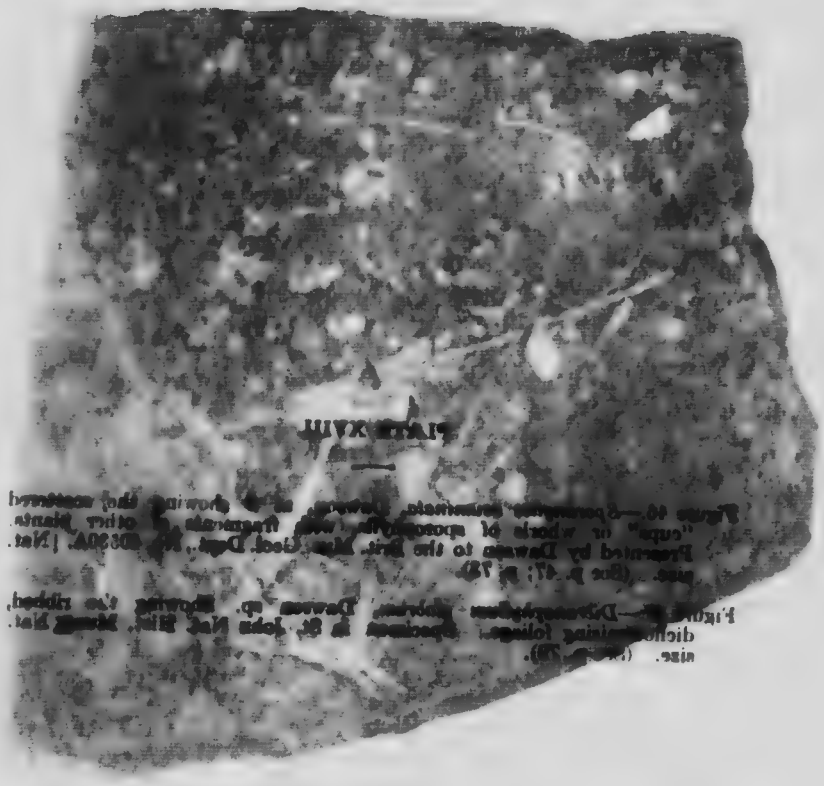

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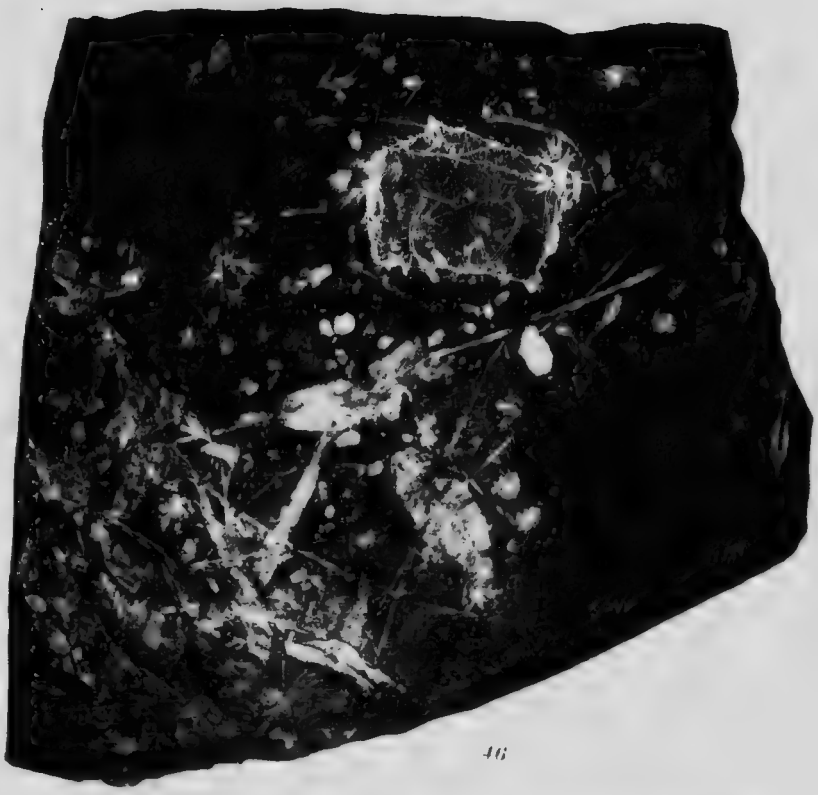

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PLATE XX.

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's 1871
at. size.

's 1871
at. size.

PLATE XXI.

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PLATE XXI.

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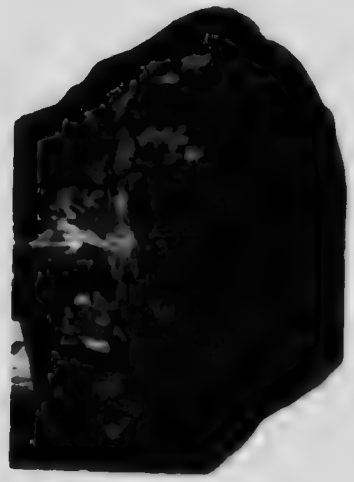

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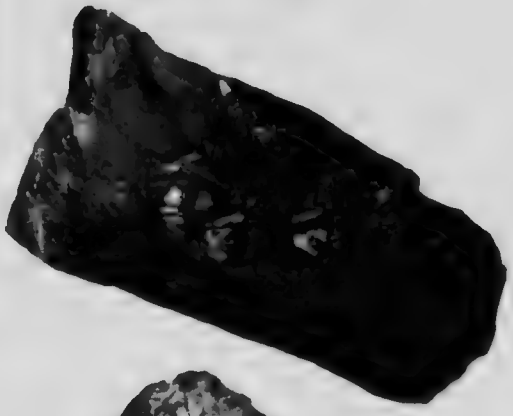

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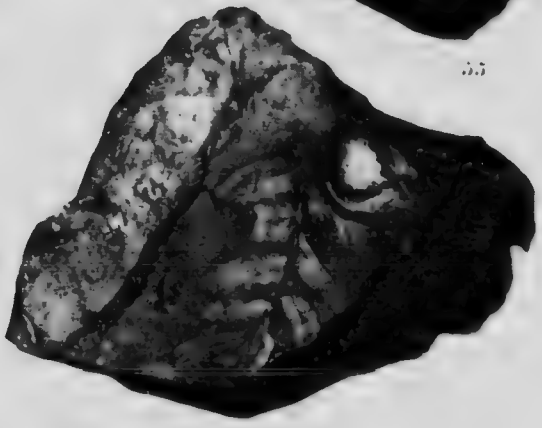

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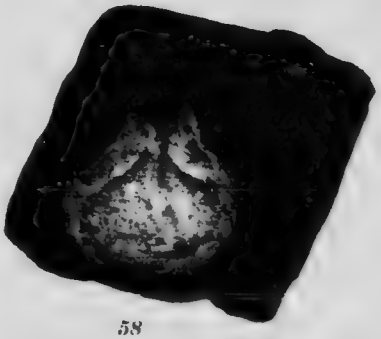

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Cardiocarpon
cornutum Dn
Ridd? Lancaster NB

PLATE XXIV.

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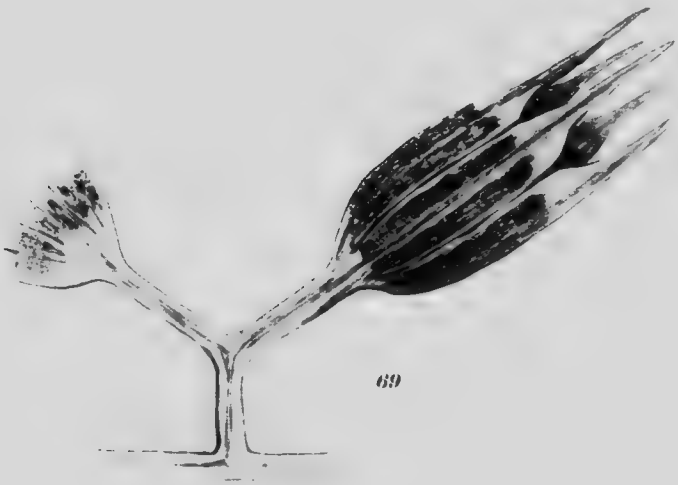

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Report on the geological position and characteristics of the oil-shale deposits of Canada—by R. W. Ells. No. 1107.

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